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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,
Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
C. L. Feldman, R. P. Kokernak, R. Lisauskas, and S. Nydick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243346, Price codes: A05 in paper copy, A01 in microfiche. Final Report 1981. 72 p, 23 Fig, 47 Ref. OWRT (1165/No 2736)(1).

Descriptors: *Compressible flow, *Kinetics, *Multiphase flow, *Model studies, *Sound waves, Compressibility, Fluid flow, Friction, Fluid mechanics, Hydraulics, Hydrodynamics, Mathematical studies, Model testing, Linear programming, Experimental design, Experimental data, Theoretical analysis, Acoustics, Mechanical engineering.

A linearized model for transmission of a plane wave through a single component two-phase bubbly mixture was developed. Data from assessment of the compressibility of a single bubble under a pressure pulse were used in a scattering model to predict the speed of sound, and resulting in the determination of the speed of sound as a function of frequency. The results clearly demonstrate the effects of phase change and heat transfer at low frequencies with resonance and cut-off at higher frequencies. The experimental model generated speed of sound measurement by passing an acoustic tone-burst through the medium and measuring transit time (directly or as a phase lag), using a mixture created by passing saturated vapor through a porous metal filter and allowing the bubbles to rise in a saturated liquid. A partially successful attempt was made to measure the vapor fraction at the level of the acoustic transducers with a differential pressure measurement using both water and Refrigerant-12; qualittive verification was possible, with some quantitative discrepancies in the resonant frequency. Application of the sound speed model to flow in two-phase devices was also studied; various critical two-phase flow theories were examined and a model for predicting weak shock thickness was developed. This model was compared with recent experimental reports on pressure waves in boiling water. (Zielinski-MAXIMA)
W82-05910

2. WATER CYCLE

2A. General

COMBINING SITE-SPECIFIC AND REGIONAL INFORMATION: AN EMPIRICAL BAYES APPROACH,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 306-314, April, 1982. 4 Fig, 5 Tab, 20 Ref.

Descriptors: *Hydrologic models, *Probability distribution, *River basins, *Flood frequency, Data interpretation, Model studies, Mathematical models, Basins, Flood forecasting, Flood peak, Regional analysis, Frequency analysis.

The empirical Bayes theory, adapted to a hydrologic context, was used to develop a format for making inferences about unmonitored river basin sites by combining site-specific and regional data. Information from similar basins is used to improve upon inferences at a particular basin. The superpopulation concept of the Bayesian approach uses a probability distribution to randomly assign basin parameters. This concept closely resembles regionalization models and is inferred from observable regional data. The superpopulation distribution expresses the degree of similarity between two basins and treats regionalized estimators as a special case using procedures similar to James-Stein estimators. The method of moments approach which is used to infer the superpopulation is described. Although the empirical Bayes approach can have definite advantages over site-specific procedures, the latter offer better performance for basins which are very different from the majority. The empirical Bayes procedure was applied to two examples of food frequency analysis. (Geiger-FRC)
W82-05903

TOPOLOGIC MODEL FOR DRAINAGE NETWORKS WITH LAKES,
Univerity of Western Ontario, London. Dept. of Geography.
D. M. Mark, and M. F. Goodchild.
Water Resources Research, Vol 18, No 2, p 275-280, April, 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Networks, *Open-channel drainage, *Drainage, *Glacial lakes, Model studies, Channel inflow, Channels, Mathematical models, Catchment areas.

Although R. L. Shreve's probabilistic-topologic model for channel networks is successful at predicting many of the overall properties of drainage networks and drainage basins, it cannot be directly applied to networks containing lakes fed by multiple inlets. An extension of Shreve's model is presented in which networks can be represented by integer strings directly analogous to the binary strings used for trivalent channel networks without lakes. The validity limitations on integer strings are presented, along with combinatorial results and techniques for generating topologically random networks. In the case of a 596-link network in northern Ontario, when it is assumed that network element degree and type are independent of position within the integer string, good predictions of the relative frequencies of various classes of small subnetworks are obtained. When the number of lakes in the network equals zero, the model collapses to Shreve's. (Geiger-FRC)
W82-05905

LAG TIME FOR DIVERGING OVERLAND FLOW,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and N. Agiralioglu.
Nordic Hydrology, Vol 13, No 1, p 39-48, 1982. 6 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Kinematic wave theory, *Flow friction, *Overland flow, *Rainfall-runoff relationships, *Watersheds, Darcy-Weisbach equation, Chezy equation, Friction, Mannings equation, Surface runoff, Surface water, Mathematical equations.

Analytical and nomographic solutions were developed for the surface water lag time for diverging overland flow using kinematic wave theory. These solutions show that lag time for a given watershed is not constant but changes with rainfall characteristics. In order to utilize these solutions, some knowledge of the geometric parametes and friction characteristics of the watershed under study is required. Uses of the Chezy equation, Manning equation, and Darcy-Weisbach relations for friction in the calculation of lag time are presented. (Geiger-FRC)
W82-05944

ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,
Binnie and Partners, London (England).
J. Wild, and J. K. Hall.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 85-108, March, 1982. 15 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrology surveys, Developing countries, North Sumatra, *Indonesia, Rainfall, Runoff, Water quality, Oil erosion, Networks, Gaging stations, *Data collections, Groundwater, Streamflow, Evaporation, Sediment.

Results of an extensive hydrologic survey (1976-80) in North Sumatra, Indonesia, are described. The province has a considerable number of hydrometeorological stations for a developing country--85 river gages, 20 climatologic stations, and 500 rain gages for a 71,000 sq km area. However, there are gaps in data because of operating and administrative problems. Gaging equipment is concentrated in the eastern coastal area and sparse in the central highlands. Little data are available for 194l-early 1950's. In North Sumatra rainfall is influenced by the monsoon systems of southeast Asia and Australia, the equatorial double rainy seasons, and local orographic influences. Mean annual rainfall varies from 2000 mm on the east coast to 4000 mm on the western slopes of the Bukit Barisan. Nevertheless, in low rainfall regions irrigation is required for all crops from May to August and throughtout the year for bunded rice. Mean annual runoff is 900 mm to over 2000 mm. The short period off records requires that conservative growth factors be used in estimating design floods. The little available information on water quality and sediment indicates that there are high levels off bacterial pollution , and waterborne diseases are endemic. Water is satisfactory for irrigation except in some volcanic areas (hot and sulfurous) and swampy regions (acid). Soil erosion is a major problem, with average denudation rates oof 1-10 mm per year. About 250,000 groundwater wells supply 80-90% of rural water. Springs are numerous, and groundwater potential greatly exceeds demand in most regions. Some large projects are in progress--two hydroelectric stations, hydrologic surveys off the Sei Deli/Belawy estuary, water supply schemes, flood control, and irrigation. (Cassar-FRC)
W82-05949

AN EVALUATION OF FLOOD FREQUENCY ESTIMATES BASED ON RAINFALL/RUNOFF MODELING,
Geological Survey, Reston, VA.
W. O. Thomas, Jr.
Water Resources Bulletin, Vol 18, No 2, p 221-230, April, 1982. 2 Fig, 8 Tab, 12 Ref.

Descriptors: *Flood frequency, *Rainfall-runoff relationships, *Flood forecasting, Runoff, Streamflow forecasting, Model studies, Hydrologic models, Flood discharge, Flood recurrence interval.

Flood frequency estimates obtained from a rainfall-runoff model by Dawdy, et al. (1972) were evaluated by two methods: (1) partition of variance method by Lichty and Liscum (1978), a computation of the equivalent years of record for regional estimating equations based on 50 small stream sites in Oklahoma, and (2) the prediction variance method developed in this paper, a computation of the bias for synthetic flood estimates as compared to observed estimates at 97 small stream sites in eight eastern states with at least 20 years of record. Method 2 was more appropriate than Method 1 because it was not as dependent on as many assumptions as Method 1. The Dawdy model tended to underestimate extreme flood discharges based on observed record (11-29% less than observed values for a 100-year flood discharge). Since synthetic flood frequency curves based on rainfall/runoff models are highly correlated, little or no regional (spatial) information can be added to the network. The equivalent years of record for the regional estimating equation based totally on synthetic flood discharge was considerably less than the length of rainfall record used to simulate the runoff. The degree of correlation between observed and synthetic flood frequency estimates at the same site appeared to vary with recurrence interval. (Cassar-FRC)
W82-06068

WATER RESOURCES OF THE OCHLOCKONEE RIVER AREA, NORTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. A. Pascale, and J. R. Wagner.
Geological Survey Open-File Report 81-1121 (WRI), 1982. 114 p, 35 Fig, 16 Tab, 43 Ref.

Field 2—WATER CYCLE

Group 2A—General

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Data collections, Geohydrology, Rainfall-runoff relationships, Water supply, Aquifers, Groundwater movement, Aquifer characteristics, Wells, Water yield, Potentiometric level, Drawdown, Saline water, Streamflow, Flow characteristics, Chemical analysis, *Florida, Ochlockonee River basin, Floridan aquifer.

The Ochlockonee River area, in the northwest Florida panhandle, receives an average of 57 inches of rainfall per year. Water use in 1975 averaged 11.4 million gallons per day. Much of the rainfall that is not lost to evaporation enters the surficial sand aquifer, seeps to streams, or enters the water-bearing zone of the upper confining unit above the Floridan aquifer. The water-bearing zone of the upper confining unit is important for rural domestic supplies, storage of water and recharge to the Floridan aquifer. The Floridan aquifer underlies all the area and is the principal source of municipal supplies. The potentiometric surface of the upper part of the Floridan aquifer ranges from about 50 feet higher than that of the middle and lower part of the aquifer in southwestern Gadsden County to about 10 feet higher in southeastern Gadsden County. Saline water occurs naturally at relatively shallow depths within the Floridan aquifer. Stream discharge is about 1,000 million gallons per day; minimum discharge is about 285 million gallons per day. The chemical quality of most streams in the study area is acceptable for most uses. (USGS)
W82-06132

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,
Universidad Simon Bolivar, Caracas (Venequela)> Graduate Program in Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W82-06199

A DISCRETE SYSTEM STORAGE MODEL FOR ANALYZING RAINFALL-RUNOFF RELATIONSHIPS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Transactions of the ASAE, Vol 25, No 2, p 362-366, 371, 1982. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Agricultural watersheds, *Hydrographs, *Storage equation, *Rainfall-runoff relationships, Model studies, Rainfall intensity, Runoff rates, Flood peak, Excess rainfall, Storms, *Illinois, *Unit hydrographs.

A unit hydrograph method and a discrete system storage model, derived from a generalized system storage relationship proposed by Chow and Kulandaiswamy (1971), were used to quantify the quasilinear effects of rainfall-runoff relationships for small agricultural watersheds. The two watersheds near Monticello, Illinois, were less than 40 ha in size with silt loam soils and slopes up to 8%. The unit hydrographs from 30 storms varied with the storm characteristics when the ratios of peak discharge to total runoff were less than unity. Use of a discrete system storage model showed that 6 hydrologic variables of rainfall intensity and runoff rates were necessary to explain system storage relationships. Simulations of storms by both methods produced peak discharges in good agreement with observed results. Neither method accurately simulated double peaks. (Cassar-FRC)
W82-06219

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06323

ACID RAIN MODEL: HYDROLOGY MODULE,
Tetra Tech. Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W82-06360

ADVANCED CALIBRATION METHODOLOGY FOR HYDROLOGIC RAINFALL - RUNOFF SIMULATION MODELS,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, V. K. Gupta, J. L. Fulton, and F. Arfi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256603, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No LSSPA-81-6, December, 1981. 146 p, 25 Fig, 15 Tab, 59 Ref, 2 Append. OWRT B-081-OHIO and C-90320-G(9442)(2). 14-34-0001-9442.

Descriptors: *Simulation analysis, *Rainfall-runoff relationships, *Mathematical models, *Stochastic hydrology, *Surface runoff, Mathematical studies, Least squares method, Model studies, Stochastic process, Probabilistic process, Streamflow, Computer models, Watersheds, Rainfall intensity, Rainfall index, Rainfall rate, Runoff, Runoff coefficient.

Stochastic estimation techniques are presented which are capable of improving hydrologic conceptual rainfall-runoff model calibrations by accounting for streamflow measurement uncertainties (and other, additive, errors). Specifically, the autocorrelated and the heteroscedastic (changing variance) error cases are considered. The methods are shown to perform well in simulation studies, and application of the techniques to the calibration of the U.S. National Weather Services soil moisture accounting model showed superiority of the new procedures over the commonly-used simple least squares criterion. The procedures were compared under different data conditions and starting parameter values. Results indicate important phenomena needing study and accountability. Its consideration gave more consistent and conceptually-realistic parameter sets, independent of starting value and/or data characteristics. However, despite these improvements, a unique parameter set for the watershed under study was not obtained. Probable reasons for this are given. Sensitivity measures capable of aiding examination of the criterion response surface in the region of the optimum are also discussed, and their applicability demonstrated. (Zielinski-MAXIMA)
W82-06366

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,
New South Wales Univ., Kensington (Australia). School of Geography.
F. C. Bell, and P. C. Vorst.
Australian Water Resources Council, Camberra, Technical Paper No 58, 1981. 131 p, 18 Fig, 13 Tab, 83 Ref, 2 Append.

Descriptors: *Hydrologic models, *Model studies, *Parametric hydrology, *Geomorphology, *Catchment basins, Hydrologic properties, Hydrologic budget, Hydrologic aspects, Hydrologic equation, Hydrologic data, Basins, Stochastic hydrology, Mathematical models, Mathematical studies, Model testing, Surveys, Data acquisition, Channel flow.

Geomorphic parameter types most relevant to the Australian Representative Basins program were investigated, along with their likely applications in hydrologic problems. Some emphasis is placed on stream channel parameters and field information for use in deterministic modeling of hydrologic processes; attention is also given to efficient surveying techniques and the serious problems of sampling and inference caused by the high spatial variability of parameters in most basins. A developed scheme for field measurements and data presentation is delineated which was exemplified and tested in 3 Basins having contrasting characteristics. Several other Basins were briefly studied to ensure inclusion of a wide range of catchment conditions. An examination of possible applications of the data in hydrologic modeling showed that measured channel parameters can be used for satisfactory estimates of the Laurenson Runoff Routing Model constants. Further study of the physical relationships between measurable catchment attributes and model constants is needed, which should be enhanced by application of the recommended scheme for geomorphic surveying and data presentation to as many basins as practicable. (Zielinski-MAXIMA)
W82-06384

COMPARING URBAN RUNOFF MODELS,
V. P. Singh.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division Vol 61, No 2, p 53-59, February, 1981. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Hydrographs, *Urban runoff, *Model studies, Urban watersheds, Statistics, Oakdale, Chicago, Illinois, Calvin Park, Kingston, Ontario, Computers, Rainfall-runoff relationships, Hydrologic models, Runoff, Urban hydrology, Storm water.

Three urban runoff models were compared with data on two urban watersheds, Oakdale in Chicago, Illinois (5.42 ha of residential area, 45.8% impervious) and Calvin Park in Kingston, Ontario (36.2 ha of residential area, 27% impervious). The runoff models were the Road Research Laboratory Model (RRLM), the University of Cincinnati Urban Runoff Model (CURM), and the EPA Storm Water Management Model (SWMM). Using the hydrograph peak and its time for evolution showed that no one model was uniformly better than another. For hydrograph peak time estimates, RRLM was better than SWMM and CURM on both watersheds. For hydrograph peak estimation SWMM was better than CURM and RRLM on Oakdale wateshed; RRLM was better than SWMM and CURM on Calvin Park watershed. Therefore, the choice of a model depends on the criterion of comparison and the watershed in question. (Cassar-FRC)
W82-06447

ANTECEDENT MOISTURE CONDITION PROBABILITIES,
Purdue Univ., Lafayette, IN. Dept. of Hydromechanics.
D. D. Gray, P. G. Katz, S. M. Demonsabert, and N. P. Cogo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 107-114, June, 1982. 5 Tab, 16 Ref.

Descriptors: *Antecedent moisture, *Probability distribution, Model studies, Precipitation, Rainfall-runoff relationships, Hydrologic models, *Indiana, *Kentucky, Tennessee, Runoff forecasting.

Growing season Antecedent Moisture Condition (AMC) probability estimates are presented for 17 locations in Kentucky, Tennessee, and Indiana. They refer to the AMC classes used in the runoff models, Soil Conservation Service (SCS) Runoff Equation (curve number method) and the Illinois Urban Drainage Area Simulator (ILLUDAS). The three SCS Classes are I, II, and III, described as lowest, average, and highest runoff potential, respectively, with < 1.4, 1.4-2.1, and > 2.1 inches of 5-day antecedent rainfall, respectively, in the growing season. The four ILLUDAS classes range from bone dry to saturated with 5-day antecedent rainfall of $0 > 1$ inches. The locations studied had a mean of 84.8% in the SCS Class I and a more even distribution of the ILLUDAS classes, 27.3%, 37.8%, 16.6%, and 23.6% in Classes I through IV, respectively. Equations are given for computing probability of occurrence of the AMC classes for other areas. (Cassar-FRC)
W82-06451

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, and E. L. White.
Water Resources Bulletin, Vol 18, No 1, p 95-98, February, 1982. 3 Fig, 2 Tab, 6 Ref. OWRT-A049-PA.

Descriptors: *Unit hydrographs, *Disribution graphs, *Flood peaks, Flood hydrographs, Flood discharge.

Synthetic unit hydrographs, which are used to estimate flood peak and volume for ungaged watersheds, should be easy to construct without a major watershed data collection effort, should have a smooth and single valued shape, and should contain a runoff volume equal to one unit (inch, centimeter, or millimeter) of rainfall excess. Most of the methods for generating these artificial unit hydrographs involve hand fitting a curve over a few selected points on the unit hydrograph. This task may be subjective and, in addition, the user may neglect or find it difficult to adjust the generated unit graph to a runoff value of one unit. A simple method which can be used to fit a smooth gamma distribution over a single point specified by the unit hydrograph peak and the time to peak with a guaranteed unit depth of runoff is demonstrated. The two values used can be determined by conventional synthetic hydrograph procedures. A comparison of this method with Snyder unit hydrographs indicated that the gamma distribution may tend to produce a somewhat broader crest than the Snyder graph, compensated by a steeper recession limb. An added advantage of the gamma distribution is that it can be convoluted analytically with several shapes of rainfall distributions. (Carroll-FRC)
W82-06586

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,
Z. N. Debrovol'skaya, G. P. Epikhov, P. P. Koryavov, and N. N. Moiseev.
Water Resources, Vol 8, No 3, p 226-241, May/June, 1981. 4 Fig, 25 Ref. Translated from Vodnye Resursy, No 3, p 33-51, May/June, 1981.

Descriptors: *Model studies, *Water quality, *Hydrodynamics, *Mathematical models, Flow, Prediction, Water management, Channel flow, Groundwater movement, Fate of pollutants, Boundary conditions, Lakes, Water Currents, Water circulation, Wind-driven currents, Numerical analysis, Hydraulics.

Results of recent work on mathematical modeling of the dynamics and quality of water are reviewed. Mathematical modeling at the Academy of Sciences of the USSR is aimed at creating a software system for automated design of water management problems. One-dimensional models of channel flow, the simplest mathematical models for studying unsteady flow in canals and river systems, are based on the classical system of St. Venant equations. The interaction of surface waters and groundwater of an arbitrary river basin may be modeled by adding the Boussinesq equations describing groundwater movement in a horizontal seepage approximation to the one-dimensional channel flow models. Two-dimensional models describe more complex hydrodynamic processes and can handle a broader class of applied problems. There are two types of such models: horizontal plane and vetical plane. Three-dimensional models can provide information on complex spatial movements in water bodies of an artibrary from under the effect of various physical factors. Examples of the model equations and sample problems are given. (Cassar-FRC)
W82-06613

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,
Maryland Univ., College Park. Dept. of Civil Engineering.
T. R. Bondelid, R. H. McCuen, and T. J. Jackson.
Water Resources Bulletin, Vol 18, No 1, p 111-116, February, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Mathematical models, *Sensitivity analysis, *Runoff coefficient, Error analysis, Remote sensing, Flood peak, Hydrologic models, Runoff volume, Pennsylvania.

The Soil Conservation Service (SCS) hydrologic models are being used increasingly for hydrologic design due to their relative accuracy, their flexibility, and their ability to use remotely sensed data. The primary input parameter for the SCS models is the runoff curve number, which is defined in terms of land use treatments, hydrologic condition, antecedent soil moisture, and soil type, permitting easy application of the models to ungaged watersheds. The accuracy of models using the runoff curve number for estimating design peak discharge and runoff volume is especially sensitive to the estimated curve number values. This study was designed to quantify in as straightforward a manner as possible the changes in runoff volume and peak discharge computations as a function of changes in curve number estimates. The hydrologic effects of curve number variation are evaluated in terms of the proportional changes in total runoff and peak discharge for a unit change in curve number. A series of curves is developed which demonstrates that the effects of variation in curve number decrease as design rainfall depth increases, such as for larger storm events. The value and use of these sensitivity curves are demonstrated using a comparison of Landsat and conventionally derived curve numbers for three watersheds in Pennsylvania. (Carroll-FRC)
W82-06631

HYDROLOGY OF SALT WELLS CREEK--A PLAINS STREAM IN SOUTHWESTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div.
H. W. Lowham, L. L. Delong, K. R. Collier, and E. A. Zimmerman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201211, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-62, April 1982. 52 p, 32 Fig, 2 Tab, 24 Ref.

Descriptors: *Small watersheds, *Hydrologic cycle, *Intermittent streams, *Geochemistry, Streamflow, Snowmelt, Storm runoff, Rainfall runoff relationships, Flushing, Salts, Sediment yield, Channel morphology, Aquatic environment, Energy, *Wyoming, Colorado River basin, Green River basin, Salt Wells Creek.

Development of energy minerals in plains areas of Wyoming is expanding rapidly. Such development may affect water resources and hydrologic relations of the plains; however, little information exists concerning hydrologic processes for these areas. This report summarizes results of a hydrologic study made during 1975-78 of Salt Wells creek, a drainage area of about 500 square miles located southeast of Rock Springs, Wyoming. The area is typical of arid and semiarid plains areas in southwestern Wyoming where mineral development is occurring. Salt Wells Creek is predominately an intermittent stream. Numerous springs in the headwaters cause small perennial flows in some upstream tributaries, but evaporation, freezeup, and seepage deplete these flows so that the middle and lower reaches of the main channel have only intermittent flows. The intermittent nature of streamflow affects water quality. It was observed that a flushing of dissolved solids and suspended sediment occurs during the first flows of a runoff event. A striking feature of the stream is its deeply incised channel. The downcutting is attributed to the cummulative effects of: (1) a change in the relative climate, amounts of annual precipitation occurring as rain and snow, (2) change in base level due to downstream channelization, and (3) changes in land use. Because of the incision, erosion is now expanding to include intervening tributaries. (USGS)
W82-06679

HYDROLOGY AND MODEL OF NORTH FORK SOLOMON RIVER VALLEY, KIRWIN DAM TO WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, and L. E. Stullken.
Available Univ. of Kansas Publ. Lawrence, Kansas. Kansas Ggeological Survey Irrigation Series 6, 1981. 34 p, 11 Fig, 2 Plates, 2 Tab, 11 Ref.

Descriptors: *Surface-groundwater relations, *Agriculture, *Aquifer characteristics, *Drought, Water shortage, Model studies, Irrigation water, Reservoirs, Rainfall-runoff relationships, Natural recharge, Groundwater storage, Water use, Wells, Water level, *Kansas, North Fork Solomon River valley.

Reservoir releases are the principal source of irrigation water in the North Fork Solomon River valley between Kirwin Dam and Waconda Lake. An extended drought in the 1970's caused severe water shortages. Ground water has been pumped from the alluvial aquifer in the valley to supplement irrigation supplies. Although annual pumpage increased to about 12,300 acre-feet in 1976, storage in the aquifer increased about 45,000 acre-feet from 1946 to 1976 as a result of recharge from surface-water irigation. A digital model was used to simulate aquifer conditions prior to closure of Kirwin Dam. Model results estimated recharge of 11,700 acre-feet per year from precipitation and discharge of 11,500 acre-feet per year from the aquifer to the river. Since 1946, discharge to the river has increased about 4,000 acre-feet per year. The analysis is inconclusive regarding effects of additional development, but the aquifer probably could sustain pumpage at the 1976 rate for several consecutive years of drought. (USGS)
W82-06684

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
For primary bibliographic entry see Field 4A.
W82-06826

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,
Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2B.
W82-06838

APPLICATION OF SCS INFILTRATION MODEL,
For primary bibliographic entry see Field 4D.
W82-06872

2B. Precipitation

VARIATIONS IN MOISTURE DEFICITS OVER THE MAIZE-GROWING REGION OF SOUTH AFRICA I. SPATIAL ASPECTS,
Missouri Univ.-Columbia. Dept. of Atmospheric Sciences.
J. F. Gillooly, and T. G. J. Dyer.
Water S. A., Vol 8, No 1, p 1-8, January, 1982. 11 Fig, 18 Ref.

Descriptors: *Rainfall, *Spatial distribution, South Africa, Distribution, Precipitation, Precipitation rate, Depth-area-duration analysis, Moisture deficiency, Moisture availability, Moisture, Evapotranspiration, Plants.

This paper deals with the spatial variations of the aridity index, termed the moisture deficits, over the officially defined maize-growing region of South Africa. This area produces about 95% of the total maize production and covers about 530,000 square kilometers. Measurements were taken of aridity for each of 25 weather stations. The total accumulated moisture deficit from July to the end of March provided the needed measure. It is noted that areas of high production coincided with areas experiencing large total moisture deficits. High production intensities were obtained through large areas being cultivated rather than high yields per se. When the intra-annual variation of mean monthly moisture deficits was determined over the maize growing

area, it was noted that the greatest variation occurred in the west and decreased in an easterly direction. Due to the erratic nature of rainfall over South Africa, monthly deficits of moisture were highly variable over time. Confidence limits were useful in determining the reliability of obtaining a particular monthly deficit in any given region. These results were then compared to the spatial patterns exhibited by the lower, median and upper quantities of rainfall, and found to be strongly related to the seasonal progression of rainfall from east to west across the maize growing area. (Baker-FRC)
W82-05901

ON PREDICTING THE ONSET OF THE AUSTRALIAN WET SEASON AT DARWIN,
Australian Numerical Meteorology Research Center, Melbourne.
N. Nicholls, J. L. McBride, and R. J. Ormerod.
Monthly Weather Review, Vol 110, No 1. p 14-17, January, 1982. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Rainfall, *Forecasting, *Prediction, *Weather forecasting, Weather data collections, Weather, Monsoons, *Australia, Darwin.

An index of the data of onset of the North Australian wet season is defined based on rainfall received at a single station at Darwin. This index can be predicted some months ahead of the onset. The total rainfall received over the period of the wet season is only weakly related to the onset index. Mid-late (December-May) season rainfall is totally independent of the date of onset and of the amount of early (September-November) rainfall. As noted in earlier research, the North Australian wet season is monsoonal in character. The current evidence suggests that the monsoon onset is preceded by a transition season, which at Darwin accounts for about 30% of the total wet-season rainfall, and there is also considerable temporal organization of transition season rainfall. This finding is supported by the fact that the date of accumulation of as little as 50 mm of rain is related to earlier months' pressure observations. (Baker-FRC)
W82-06208

ON A STATISTICAL RELATIONSHIP BETWEEN AUTUMN RAINFALL IN THE CENTRAL EQUATORIAL PACIFIC AND SUBSEQUENT WINTER PRECIPITATION IN FLORIDA,
Scripps Institution of Oceanography, La Jolla, CA.
A. V. Douglas, and P. J. Englehart.
Monthly Weather Review, Vol 109, No 11, p 2377-2382, November, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Rainfall, *Prediction, *Weather forecasting, *Florida, Gulf of Mexico, North Atlantic, North Pacific.

Attention is drawn to one strong and apparently useful teleconnection between autumn rainfall in the central equatorial Pacific and subsequent winter precipitation in south-central Florida. The regression equation relating the fall rainfall index and winter precipitation in south central Florida is based on 28 years of data. While a strong statistical relationship appears to exist between rainfall in Florida and the equatorial Pacific, the physical mechanisms associated with the teleconnection are undoubtedly complex. Examination of Northern Hemisphere 700 mb anomaly maps for wet and dry years along the equator has provided some insight. In preparing these maps, winter height anomalies were composited for six years with high autumn rainfall along the equator and six years with below-normal rainfall. Large scale circulation changes associated with warming events in the eastern tropical Pacific are noted. After the establishment of a warm-set regime in the eastern Pacific, the winter circulation becomes abnormally strong across the eastern North Pacific, Gulf of Mexico and western North Atlantic. The development of heavy precipitation in Florida is probably a result of a vigorous low-latitude mean flow across North America and increased frontal activity in the Gulf of Mexico. Cyclogenesis in the Gulf of Mexico may also increase during these winters. (Baker-FRC)
W82-06209

AUTOCORRELATIONS OF MOISTURE PARAMETERS ON ISENTROPIC SURFACES,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
J. S. Boyle.
Monthly Weather Review, Vol 109, No 11, p 2401-2404, November, 1981. 1 Fig, 20 Ref.

Descriptors: *Specific humidity, Mathematical studies, *Moisture, *Humidity, Atmospheric water, Atmosphere, Weather, *Weather forecasting, Prediction.

This note presents some spatial autocorrelation results for moisture variables on isentropic surfaces. These results appear to impact on the selection of an optimal technique for synoptic-scale moisture analyses. It was found that, within the context of the procedures used and for the case studied, the values of autocorrelation for specific humidity were greater than that of relative humidity for all separation distances considered, and that for almost all distances considered, the autocorrelation of specific humidity displayed a more gradual decrease with separation distance than did that of relative humidity. These findings are in concert with meteorological experience and indicate that some gains may be made in the accuracy of the moisture analysis by using specific humidity as the analyzed quantity. It is noted that an objective analysis scheme can make more effective use of the available moisture information if the analysis is made of specific humidity on isentropic surfaces rather than relative humidity on pressure or isentropic surfaces. (Baker-FRC)
W82-06210

RAINFALL AND ATMOSPHERIC CIRCULATION DURING DROUGHT PERIODS AND WETTER YEARS IN WEST AFRICA,
National Center for Atmospheric Research, Boulder, CO.
S. E. Nicholson.
Monthly Weather Review, Vol 109, No 10, p 2191-2208, October, 1981. 17 Fig, 4 Tab, 33 Ref.

Descriptors: *Rainfall, *Variability, Atmospheric water, Drought, Sahara Desert, Arid climates, Africa, *West Africa, Climatology, *Rainfall distribution, Precipitation.

Rainfall variations of the present century over a large section of the African continent were investigated. The general climatology of the areas of the African continent were investigated. The general climatology of the areas in question is reviewed along with a summary of modern rainfall fluctuations in various regions, and recent extreme rainfall anomalies are described. During recent decades the Sahel and other sub-Saharan regions experienced two periods of anomalous rainfall conditions, the wet 1950's and the drought of 1968-73. A comparison of sub-Saharan droughts and wetter years suggests that a northward displacement of the Intertropical Convergence Zone may account for wetter years, but that a weakened 'intensity' of the rainy season, independent of ITCZ position, is the most likely cause of drought in the sub-Saharan region. Increased subsidence and decreased low-level convergence over the sub-Sahara and a decrease of moisture flux and upper level easterly flow into that region accompany drought years. The last factor weakens the combined barotropic-baroclinic instability mechanism which maintains the rain-producing West African disturbances, and it probably diminishes the westward steering of these disturbances. The synchronous rainfall changes on both sides of the Sahara, indicating a change in both the tropical summer rainfall regime and the extratropical winter rainfall regime, strongly imply a general intensification of the Hadley cell and perhaps an expansion of its descending branch. Further evidence of this derives from increased rainfall in equatorial regions during sub-Saharan droughts, usually associated with a contraction of the equatorial 'rainy' zone, the ascending branch of the Hadley circulation. (Baker-FRC)
W82-06211

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
S. W. Wolcott, and T. T. Warner.
Monthly Weather Revies, Vol 109, No 9, p 1989-1998, September, 1981, 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Rainfall, *Forecasting, Weather forecasting, Prediction, Satellite technology, Wind, Precipitation, Remote sensing, Model studies, Mathematical studies, *Moisture.

A moisture analysis procedure is presented that uses satellite, precipitation and surface specific humidity data to augment the standard radiosonde observation (RAOB) of moisture. Mesoscale forecasts were made to determine the effect of the high-resolution moisture analysis on the forecast of precipitation. The analysis procedure uses the RAOBs as the primary source of synoptic scale information, with the other sources adding mesoscale detail to the analysis. Precipitation data and satellite-determined cloud data provide the basis for a relative humidity constraint with the potential for providing high-resolution information, whereas the surface specific humidity analysis introduces fine scale information on low level moisture patterns. All forecasts produced rainfall amounts considerably smaller than those observed, even though the positioning of the rain events was good. The most realistic rainfall amounts were produced by the mode when the saturation constraint was imposed by the use of satellite and surface observed 'present weather' data. Rain rates during the first 4 hr of these forecasts were 100% larger and more realistic than the rain rates produced when these data were not used. The fine scale structure to the moisture field at the lowest model level as provided by surface based specific humidity data did not significantly affect the precipitation prediction. A strong synergistic effect exists between the initial latent heat release in the model and the divegence field that exists in the model initial conditions. The extent of the positive influence of the satellite and surface present weather data, at least during the early hours of the forecast, was probably related to the existence of the relatively sophisticated divergent wind initialization. (Baker-FRC)
W82-06212

THE 1980 SUMMER HEAT WAVE AND DROUGHT IN HISTORICAL PERSPECTIVE,
National Climatic Center, Asheville, NC.
T. R. Karl, and R. G. Quayle.
Monthly Weather Review, Vol 109, No 10, p 2055-2073, October, 1981. 16 Fig, 1 Tab, 17 Ref.

Descriptors: *Drought, *Weather patterns, Weather data collections, Soil moisture, United States, Climates.

The summer of 1980 is put into historical perspective with the aid of state temperature and precipitation averages for the 48 continguous states of the United States 1985. Several other variables and indices were also derived to assess the oppressive weather during this particular summer. These indices include the Palmer Drought Severity Index (PDSI) and Palmer's soil moisture abnormality index (Z Index). Population-weighted cooling degree days as related to electrical energy sales and the deficit of the precipitation minus the potential evapotranspiration were also used in the assessment. The heat during the summer of 1980 was near record levels in many states throughout the Southern Plains and eastward along the Gulf Coast to the Atlantic. Probably the most notable aspect was the most anomalous areas followed two decades of relatively cool summers. the cooling degree day total across the nation during the cooling season of May-October was the highest since 1959. Electicity consumption reached new peaks, partly as a result of natural growth and partly because of the increased air conditioning load. Economic losses during this hot, dry summer were estimated at $16 billion. However, during the 1930's and 1950's even worse conditions had existed. (Baker-FRC)
W82-06213

TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
E. B. Rodgers, and R. F. Adler.
Monthly Weather Review, Vol 109, No 3, p 506-521, March, 1981. 13 Fig, 2 Tab, 25 Ref.

Descriptors: *Satellite technology, *Rainfall distribution, Nimbus, Remote sensing, Data collections, Precipitation, Rainfall, Cyclones, Tropical cyclones, Storms, Hurricanes, Pacific Ocean.

Results are presented from the calculation of the magnitude and distribution of rainfall in Pacific Ocean tropical cyclones using the EMSR-5 data (Nimbus-5 Electrically Scanning Microwave Radiometer). Approximately 70 satellite passes over tropical cyclones in various states of development were used. All storms examined reached typhoon or hurricane stage sometime during their lifetime. The data have been useful in determining the rainfall characteristics of these storms and appear to be potentially useful in monitoring and making short term predictions of their intensity. Comparison of the ESMR-5 derived total storm rainfall calculations with previous estimates based on moisture budget computations or composited rainfall statistics indicate good agreement for both mature systems (typhoons) and disturbances, except in the inner core, where ESMR-5 measurements seem to understimate rainfall rate. The calculations confirm that total typhoon rainfall is about twice that found in disturbances. Case studies as well as composite studies indicate that the increase in the ESMR-5 derived latent heat release corresponds to storm intensification. In addition, the relative contribution of the heavier rainfall rates to the total storm rainfall also increases as tropical cyclones intensify. A tendency was also noted for the rainfall to concentrate toward the center during intensification. Comparisons of eastern Pacific Ocean hurricanes and western Pacific Ocean typhoons shows that the eastern storms have less LHR, are more compact and have less intense rainfall. (Baker-FRC)
W82-06214

OBJECTIVE ANALYSES AND MAPPING TECHNIQUES FOR RAINFALL FIELDS: AN OBJECTIVE COMPARISON,
Centre National de la Recherche, Scientifique, Grenoble (France). Inst. de Mecanique.
J. D. Creutin, and C. Obled.
Water Resources, Vol 18, No 2, p 413-431, April, 1982. 13 Fig, 37 Ref.

Descriptors: Rainfall, *Mapping, *Precipitation, *Isohyets, *Statistical analysis, Spatial distribution, estimating, Regression analysis, Mathematical studies, Correlation analysis, Field investigations, Isotropy.

Techniques to estimate point or average values of rainfall fields at ungaged sites are reviewed. Some theorectical developments and practical aspesct of various techniques are cited. In general, it was concluded that interpolation methods provide better results than smoothing techniques. No statistical methods are able to fully account for both the climatological and spatial properties of rainfall fields. A case study is presented for a region with particularly high rainfall variability, the Massif Central in France, to compare the sensitivity of various techniques. Correlation and contingency analyses were conducted. Results suggest that the Gandin method is preferred by hydrologists, because it requires only one calibration, it provides the estimation error variance as a by-product, and it is the most computationally efficient. (Titus-FRC)
W82-06327

CALCULATIONS OF HAILSTONE GROWTH IN A SLOPING STEADY UPDRAFT,
Chicago Univ., IL. Dept. of Geophysical Sciences.
W. D. Robinson, and R. C. Srivastava.
Atmosphere-Ocean, Vol 20, No 1, p 76-89, 1982. 8 Fig, 24 Ref.

Descriptors: *Hail, *Cloud physics, Precipitation, Model studies, Air circulation, Fleming storm, Rainstorms.

Hail growth in a model cloud was investigated with analytical solutions to equations of growth and motion in hailstones in updrafts. Cloud water contents varied linearly with height. The two-dimensional steady state model of a storm consisted of several sections in the horizontal and the vertical in each of which the vertical air velocity and the effective cloud water content were linear or piecewise linear functions of height and were consistent in the horizontal direction. This procedure approximated the Fleming storm. Hail embryos (0.1 cm in diameter) were introduced at several positions in the updrat from 5 to 10 km. Spacings were 1 km and 0.5 km in the vertical and horizontal dimensions, respectively. The largest hailstones (up to 5.7 cm) were formed from embryos starting near the (right) downshear edge of the updraft. These embryos recirculated, with the number of recirculations and final size being greatest in those embryos originating nearest to the turnover location of the updraft. Small hailstones (< 0.5 cm), likely to melt before reaching the ground, were formed from embryos starting in the central portions of the updraft and near the upshear edge of the updraft. (Cassar-FRC)
W82-06526

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
P. L. Smith.
Atmosphere-Ocean, Vol 20, No 1, p 4-16, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Rain, *Fluid drops, *Particle size distribution, Graphical analysis, Mathematical studies.

Five graphical methods for describing raindrop size data are discussed. These methods can determine the form and estimate the parameters of drop size distribution functions. Each gives a different view of drop size distribution and each has certain advantages in different applications. All methods show that drop size distribution is approximately exponential. The pioneering work of Marshall and Palmer (1948) is less satisfactory for many purposes than subsequently developed methods. The most useful forms for fitting functions to observed drop size data are the semilogarithmic plot of the inverse cumulative drop size distribution vs. drop diameter and a plot of normalized cumulative mass concentration vs. normalized drop diameter. They are also useful in examining the possibility of truncation of distribution. (Cassar-FRC)
W82-06529

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,
Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
For primary bibliographic entry see Field 7B.
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-06531

ON ACCUMULATION OF WATER SUBSTANCE IN A COLUMN OF RISING AIR,
National Severe Storms Lab., Norman, Ok.
E. Kessler.
Atmosphere-Ocean, Vol 20, No 1, p 62-68, 1982. 1 Fig, 11 Ref.

Descriptors: *Condensation, *Air circulation, *Storms, Clouds, Model studies, Precipitation, Updrafts, Meteorology, Hail.

The accumulation of condensed water in moist rising air is related to the ratio of air speed to the fall speed of precipitation. Maximum accumulation occurs when the ration is near unity. Accumulation of water is considered in one-dimensional time-dependent distributions in three model situations: (1) updrafts are substantially less than precipitation fall speeds (weak updrafts), (2) updrafts and fall speeds are about equal (moderate updrafts), and (3) updrafts are substantially greater than fall speeds (strong updrafts). The accumulation is described by equations reflecting the relative importance of vertical advection, condensation, and three-dimensional divergence of rising air. Equations also define the times required for almost steady conditions to be achieved in the saturated rising columns. The length of the transient phase is proportional to the inverse of the precipitation fall speed in weak updrafts and to the inverse of air speed in moderate or strong updrafts. An idealized figure reveals how precipitation predominates at the base of weak updrafts and throughout most of the depth of moderate updrafts. A strong updraft is marked by cloud at lower altitudes, with precipitation mostly confined to altitudes above the updraft maximum. (Cassar-FRC).
W82-06581

THE EFFECT OF PRESSURE ON THE BREAKUP OF ONE PAIR OF RAINDROPS,
Toronto Univ. (Ontario). Dept. of Physics.
R. List, and C. Fung.
Atmosphere-Ocean, Vol 20, No 1, p 17-27, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Fluid drops, *Rain, *Coalescence, Kinetics, Precipitation, Atmospheric pressure.

A new apparatus measured the effect of pressure on the breakup types and fragment spectra resulting from water drops with diameters of 2.61 and 1.17 mm colliding while moving vertically at terminal speed. The same types of breakup were observed at 50 to 100 kPa. Pressure did not appear to affect fragment size distribution for breakup into filaments, sheets, and disk patterns; average fragment numbers; or coalescence efficiency. Whenever the larger drop was hit in a glancing fashion, a neck of filament was formed. A more central collision led to a two-dimensional sheet of water ripping out of the larger drop, with the smaller drop disappearing. A central hit produced a horizontal disk. These breakup types occurred at about the same frequency as with the 3.0, 1.0 mm pair of drops at 100 kPa in a previous experiment. At kPa 2250 attempted collisions produced 104 actual collisions. Of these 104 collisions three disk modes coalesced, and 101 led to breakup. The empirical equation developed by Low (1977) and Low and List (1982) predicted the dependence of fragment numbers and size distributions on drop diameters when extrapolated from 100 to 50 kPa. However, the collision kinetic energy factor had to be adjusted by a multiplication factor. (Cassar-FRC)
W82-06761

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),
Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
L. -R. Kruger, and G. A. Schultz.
Wasserwirtschaft, Vol 72, No 1, p 1-5, 1982. 8 Fig, 7 Ref.

Descriptors: *Satellite technology, *Rainfall, *Runoff, *Convection, *Infrared imagery, Water resources development, *West Germany, Mathematical models, Mathematical equations, Clouds, Temperature effects, Air temperature, Cloudbursts, Precipitation, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, *Remote sensing, *Metrostat.

The use of data from the infrared channel of the geostationary satellite METEOSTAT to locate and analyze convection precipitation is described. The technique can be used to partly fill gaps in hydrological data that have, particularly in the

developing countries, hindered the smooth functioning of water resources projects. The METEOSTAT provides the extensive scan in terms of both time and space required to analyze the origin of convection rainfall in its local variability and quick occurrence. Rainfall data can then be convertd to runoff with the aid of a deterministic precipitation/runoff model. The satellite is located 36,000 km above the equator at 0 degrees longitude and possesses the same angular velocity as the earth (hence it is geostationary). The infrared channel (10.5-12.5 micrometers) delivers information on the temperature of ground, water, and cloud surfaces. The satellite covers 25 sq km at the subsatellite point and above 45 sq km over central Europe. It delivers an image of almost half the earth's surface about every 30 min. Using a test area of southern Germany, the data indicated that the lower the temperature of the cloud surface, the higher the probability of the existence of ice crystals and their growth (these eventually fall to the earth as rain) and the more powerful the extent of the convection cell and hence the greater the precipitation efficiency. The data also showed that a large temporal temperature change of the upper edge of the cloud is an expression of the inner dynamics of the convectional cell; a temperature drop indicates a fast rise of the cumulonimbus. The parameter that allows rain volume to be calculated from rain intensity is the area of the cloud. An equation is given for this. In principle, METEOSTAT provides infrared information for every catchment area on earth, but research is required to devise more accurate methods of interpreting the data. (Gish-FRC)
W82-06823

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,
Scripps Institution of Oceanography, La Jolla, CA.
G. K. Vallis.
Tellus, Vol 34, No 3, p 211-227, June, 1982. 17 Fig, 2 Tab, 45 Ref.

Descriptors: *Model studies, *Climates, *Climatic zones, *Climatology, Mathematical studies, Hydrology, Hydrologic models, Hydrologic cycle, *Statistical studies.

A zonally averaged statistical dynamical climate model is described, and various experiments are performed with it. The model is based on the primitive equations of motion, except that the zonally averaged zonal wind is constrained to be in a 'spherical geostrophic equilibrium' with the geopotential. The effects of large scale eddies on zonally averaged flow are parameterized using a scheme based on the work of Green. The solar and infrared radiation schemes allow interaction with the cloud cover predicted via a hydrology cycle. When integrated, the model produces realistic energetics and fields of momentum, temperature and relative humidity. The effects of moisture on the model circulation are examined. Its inclusion intensifies and narrows the upward branch of the Hadley cell, although the total width is unaltered. The response of the surface temperature to changes in the solar constant is reduced by moisture, especially at low latitudes. Relative humidity is found to have an inverse relationship to surface temperature if surface albedo is fixed. However, the presence of an ice sheet reduces low level relative humidity. Implications for simple energy-balance models and climate sensitivity are discussed. (Baker-FRC)
W82-06838

SPATIAL COHERENCE OF MONTHLY PRECIPITATION IN THE UNITED STATES,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh, M. B. Richman, and D. W. Allen.
Monthly Weather Review, Vol 110, No 4, p 272-286, April, 1982. 10 Fig, 6 Tab, 37 Ref.

Descriptors: *Spatial distribution, *Air circulation, *Weather patterns, Precipitation, Factor analysis, Synoptic analysis, Cyclones, Seasonal variation, Areal precipitation, Meteorology, Weather forecasting.

Synoptic-scale regions of the U.S. over which monthly precipitation amounts showed the greatest spatial coherence were identified by factor analysis and an orthogonal rotation to the varimax criterion. Data consisted of monthly precipitation amounts for the years 1900-77 at 61 stations. Results showed nine patterns, which permitted delineation of the large-scale circulation features most closely associated with fluctuations of regional precipitation. Correlations between regional precipitation and parameters of the 700 mb height field were significant locally and corresponded to 10-50% of the monthly precipitation variance. Patterns were consistent with previously documented cyclone trajectories, and the corresponding time series of the factor scores were highly correlated with values of the Palmer Drought Index. The seasonal continuity of the patterns was disrupted only in summer, when the predominance of convective precipitation resulted in a minimum of spatial coherence. Sea level pressure anomalies over broad areas of the Atlantic and Pacific Oceans were associated with regional precipitation in the central and eastern U.S. The correlations with precipitation along the West Coast were more localized. These results may be useful in long-range prediction of precipitation. (Cassar-FRC)
W82-06894

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 6G.
W82-06967

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,
Meteorological Satellite Center, Tokyo (Japan).
For primary bibliographic entry see Field 7B.
W82-06995

2C. Snow, Ice, and Frost

THE IMPORTANCE OF REFREEZING ON THE DIURNAL SNOWMELT CYCLE WITH APPLICATION TO A NORTHERN SWEDISH CATCHMENT,
Luleap Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 13, No 1, p 1-12, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Snowmelt, *Mathematical models, *Freezing, *Snow pack, Model studies, Temperature effects, Thaw, Snow cover, Snow melting, Mathematical studies, *Sweden.

A method for calculating night-time refreezing of the top layer of a snowpack which may be used in the degree-day technique for computing daily snowmelt rates is presented. For days with considerable variations in temperature, the total snowmelt will not be calculated accurately by the degree-day method, unless overnight refreezing is accounted for. For such days, the daytime conditions rather than the mean conditions over the whole day determine the snowmelt that takes place. The corrected model was applied to an open field and a forested area of the Bensbyn catchment area of northern Sweden. Whereas the simple degree-day method showed too fast a snowmelt rate, the refreezing-degree-day method was found to be very accurate for describing the snowmelt process. The refreezing-degree-day approach should prove easy to incorporate into existing conceptual mathematical runoff models. (Geiger-FRC)
W82-05942

COLD REGIONS ENGINEERING IN NORWAY,
Norwegian Road Research Lab., Oslo.
For primary bibliographic entry see Field 8A.
W82-06000

AN OPERATIONAL NET SHORTWAVE RADIATION MODEL FOR GLACIAL BASINS,
Toronto Univ. (Ontario), Dept. of Geography.
D. S. Munro, and G. J. Young.
Water Resources Research, Vol 18, No 2, p 220-230, April, 1982. 8 Fig, 1 Tab, 24 Ref.

Descriptors: *Net radiation, *Model studies, *Snowmelt, *Reflectance, *Glaciology, *Mapping, Radiation, Runoff, Glaciers, Ablation, Glaciohydrology, Snowline, Melting, River basins.

An operational net shortwave radiation model which is useful in mapping the distribution of shortwave radiation arriving at sloping surfaces throughout a glacier basin is described. The model is constructed by modifying existing total spectrum approaches to minimize the need for observational data during operation. Radiation distribution may be mapped under clear or cloudy skies, and knowledge of the surface reflectance field must be incorporated to estimate the net shortwave radiation absorbed by ice and snow. The model was successfully applied using topography data, monitoring of the snowline, and routine weather studies at Peyto Glacier Basin, Alberta. Model net shortwave radiation estimates were fair approximations of energy equivalents of ablation derived from stake measurements. The net shortwave radiation measurement was recommended for use in modeling the meltwater discharge of glacier basins. (Geiger-FRC)
W82-06064

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W82-06065

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W82-06082

BACTERIA UNDER THE ICE,
For primary bibliographic entry see Field 5A.
W82-06561

ALBEDO SURVEY ON ANDREI GLACIER, ISKUT RIVER BASIN, B. C., MIDSUMMER, 1980,
Department of the Environment, Ottawa (Ontario).
S. Fogarasi.
National Hydrology Institute, NHRI Paper No 15, 1981. 13 p 6 Fig, 5 Tab, 1 append.

Descriptors: Water resources, *Geological survey, *Glaciers, *Data analysis, *Statistics, Surface Contamination, *British Columbia, *Albedo, Andrei Glacier.

At nine sites on Andrei Glacier, B.C., albedo measurements were carried out on ice surfaces which were contaminated to varying degrees. Four albedo classes were derived in terms of the amount of aeolian dirt that was deposited on the ice surface. Each albedo class was associated with one of the 'white', 'whitish', 'dirty' or 'very dirty' surfaces, and each class had signigicantly different albedos, the means of which ranged from 22% to 68%. Values in each albedo group were normally distributed over time. Albedos from wet ice surfaces were found between the -2 and -3 standard deviation band of each albedo class distribution. Albedo values measured on freshly frozen ice surfaces tended to occupy the upper tail of the Gaussian normal distribution, i.e., between +2 and +3 standard deviations. Albedo values have been tabulated and plotted along a grid of 500-m mesh. Finally, suggestions are given on how to model

hourly ice surface albedo distribution over the glacier. (WATDOC).
W82-06578

2D. Evaporation and Transpiration

LIQUID LEVEL INTERFEROMETER,
Arizona Univ., Tucson. Optical Sciences Center.
For primary bibliographic entry see Field 7B.
W82-05929

REGIONAL WATER BALANCE ON THE ARCTIC TUNDRA IN SUMMER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 301-305, April, 1982. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Tundra, *Evaporation, *Precipitation, *Arctic zone, *Altitude, *Hydrologic budget, Evaporation rate, Energy, Lysimeters, Runoff, Snowmelt, Hydrologic data collections, Snow cover.

During the summers of 1969 and 1970, the regional distributions of evaporation and precipitation were examined on the arctic tundra on Axel Heiberg Island, Northwest Territory, Canada. Measurements were made using small weighing lysimeters and Canadian standard rain gauges stationed at eight locations ranging in altitude from sea level to 800 m above the means sea level. During the snow-free period, the means evaporation rate increases slightly with altitude. At higher altitudes, the total evaporation for the snow-free period is shorter due to the longer duration of the snow cover. The total summer evaporation is at a maximum in the 100-600 m altitude range, while total summer precipitation increases steadily with altitude, exceeding evaporation at about 500 m. Below 500 m, most of the annual runoff occurs during and immediately after the winter snowmelt. Above this altitude, runoff takes place throughout the summer. (Geiger-FRC)
W82-06061

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 291-300, April, 1982. 6 Tab, 3 Fig, 18 Ref.

Descriptors: *Arctic zone, *Tundra, *Evaporation rate, *Snowmelt, *Precipitation, *Runoff value, Arctic, Hydrologic data collections, Evaporation, Sublimation, Lysimeters, Snow cover, Rime, Snowdrift, Energy, Hydrologic budget.

Hourly and daily evaporation rates were recorded on arctic tundra during an energy balance program of the Axel Heiberg Island Expedition in spring and summer of 1969, 1970, and 1972. Objective criteria were developed to accept or reject the aerodynamic profile method of data collection for the Bowen ration energy balance procedure. Readings from the snow lysimeter and the ordinary weighting lysimeter were affected by snowfall, snowdrifting, rime deposition and lack of ventilation. The annual total evaporation for the base camp of the Axel Heiberg Island Expedition was estimated at 140 mm. This rate increases slowly from April to the beginning of the melt in mid-June, while the ratio of latent heat flux to net radiation decreases. The maximum annual evaporation rate is observed immediately after the melt. Total evaporation during the snow-free period accounts for about 85% of the annual total evaporation. Winter snow cover at the base camp contains an average water equivalent of 76 mm, while summer precipitation averages 95 mm. It was estimated that as much as 80% of the annual precipitation is lost into the atmosphere through evaporation, leaving only 20% for runoff, which occurs mostly during and immeditely after the melt period. (Geiger-FRC)
W82-06065

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,
Rhode Island Univ., Kingston. Dept. of Chemistry.
P. I. Abell.
Nature (London), Vol 297, No 5864, p 321-323, May 27, 1982. 3 Fig, 20 Ref.

Descriptors: *Lake evaporation, *Isotope studies, *Paleoclimatology, *Oxygen, *Lake sediments, *Sedimentology, *Gastropods, Evaporation, Isotopic tracers, Climatology, Water level fluctuations, Lakes, Air temperature, Relative humidity, *Kenya, Lake Turkana.

The well-preserved mollusc shells in the sedimentary column of Lake Turkana, Kenya were utilized to study the palaeoclimatology of the area using an oxygen isotope technique. The shells of three species of abundant gastropods were ground to a powder and examined for aragonite/calcite ratios and oxygen isotope (O18/O16) ratios. The sensitive oxygen isotope record varied over a range of 7%, reflecting higher evaporative levels of the heavier oxygen isotope in lake waters during periods when the lake was closed, alternating with isotopically lighter freshwater during periods when the lake was open. The mapped climatic trends derived from this technique are comparable to those observed in parts of Africa today. The warm/dry periods which have characterized much of the past at Lake Turkana and which prevail today have also been noted in oxygen isotope ratios from modern gastropods at Lakes Victoria, Edward, Albert, and Kivu, suggesting that temperature rather than relative humidity is the major factor controlling the evaporative concentration of O18. (Geiger-FRC)
W82-06216

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,
Northeastern Forest Experiment Station, Durham, NH.
C. A. Federer.
Water Resources Research, Vol 18, No 2, p 355-362, April, 1982. 5 Tab, 6 Fig, 23 Ref.

Descriptors: *Simulation analysis, *Mathematical models, *Transpiration, *Atmosphere, *Soil environment, Stomatal transpiration, Water loss, Transpiration depletion, Flow roots, Plant-water potential, Water potentials, Field investigations, *Maine.

The accuracy and usefulness of two forms of water demand functions and two forms of water supply functions are considered. The effects of various soil and plant factors on transpiration are examined using a simulation model to produce transpiration values. The model simulates diurnal and seasonal behavior of plant and soil water potentials, stomatal conductance, and transpiration, and has been tested on two hardwood forests. Data from a birch-oak-pine forest in southern Maine were used. The study showed that the best estimate of atmospheric demand, unstressed transpiration, can be obtained by the Penman equation for short vegetation, but with forest canopies, transpiration is highly variable. The best estimate of supply incorporates depth variation of soil water potential and of root and soil properties, but a more practical index can be used which measures the fraction and available water in the root zone. Results of the study suggest that supply is less than demand only when the soil is very dry. (Titus-FRC)
W82-06320

POTENTIAL EVAPORATION IN THE PEACE REGION OF BRITISH COLUMBIA,
British Columbia Ministry of Environment, Victoria.
R. L. Davis, and J. A. Davies.
Atmosphere-Ocean, Vol 19, No 3, p 251-260, 1981. 5 Fig, 13 Ref.

Descriptors: *Evaporation, *Net radiation, *Energy, Model studies, Peace River, *Briish Columbia, Pastures, Solar radiation, Radiation.

The Priestly and Taylor (1972) model for potential evaporation performed well when tested with micrometeorological data collected over pasture in the Peace River region, British Columbia. Data were collected from mid-May until late August, 1977, during which a total of 285 mm of precipitation fell on 55 days. The volumetric soil moisture content of the root zone always exceeded 32%, insuring evaporation at the potential rate. The root mean square error was less than 10% of the mean evaporation rate on a daytime basis using an alpha rate (vapor pressure deficit) of 1.26. Net radiation, rarely measured in remote areas, was estimated from more readily available meteorological data. On the average, calculated results of net radiation were 7% higher than observed values, producing a 7% overestimate of evaporation. Calculated results of net radiation were also within 20% of measured values on a daily basis and within 10% on a 5-day mean basis. (Cassar-FRC)
W82-06528

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,
Bureau of Land Management, Denver, CO.
B. P. Van Haveren.
Water Resources Bulletin, Vol 18, No 3, p 533-536, June, 1982. 6 Fig, 2 Ref.

Descriptors: *Measuring instruments, *Evaporation pans, Evaporation, Flow discharge, Remote sensing, Telemetry, Automation.

A simple, reliable, and relatively inexpensive automated recording system for evaporation plans is described. With this system, a continuous record of pan evaporation is obtained. The evaporation station may be left unattended for periods of up to 30 days, and with incorporation of a data telemetry system, could be operated on a real-time basis. Measurement sensitivity and frequency of maintenance trips can be determined by the investigator simply by choice of reservoir diameter and volume. The system is particularly well suited for remote evaporation stations. The major advantages of the system over conventional, manually read evaporation pans are: (1) savings in manpower and travel expenses, (2) continuous recoding function, and (3) adaptability to real time data acquisitions systems. Data retrieval and storage can be by conventional paper strip chart, punch tape, cassette tape data logger, or telemetry. The system could be operated in cold weather by substituting a mixture of methanol and water for water in the evaporation pan. For more sophisticated applications, the float valve can be replaced by an electronic circuit to sense water lever and a solenoid valve to control water flow to the pan. (Baker-FRC)
W82-06780

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),
Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
J. Werner.
Wasserwirtschaft, Vol 72, No 1, p 18-22, 1982. 6 Fig, 15 Ref.

As a result of several years' investigation of energy exchange at the boundary of water and air, equations for the calculation of this phenomenon are given whose practicability has been proven. The use of these equations in an arithmetic model opens up the possibility of extrapolation to extreme situations, whether these caused by a long period of extraordinary atmospheric conditions or changes in the natural temperature balance of a body of water induced by man (e.g., warmth from a wastewater stream). Developments in microprocessor technology have made it possible to monitor energy exchange at water surfaces continuously by means of a floating buoy and to balance them in situ. The buoy allows determination of evaporation loss as well as arithmetic simulation of equilibrium temperatures. The simplest form of such a buoy is furnished with a device for measuring radiation balance, a cup anemometer and an evaporation psychrometer. The buoy

should be about 1 m high so that maintenance can be carried out comfortably from a boat, and this permits calculation of energy exchange up to 3.3 m above the water surface. In running water a flow meter should be installed to distinguish the relative movement between water and air from wind speed actually affecting the surface. Equations are given for the calculation of short- and long-wave radiation exchange and of the vertical flows of latent and perceptible heat. The temperature of water is determined by the total radiation exchange, which in turn is determined by energy gain from global radiation and by heat loss through reflected radiation as well as by evaporation loss and the exchange of perceptible heat. (Gish-FRC)
W82-06824

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
M. E. Andersen, and H. E. Jobson.
Water Resources Research, Vol 18, No 3, p 630-636, June, 1982. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Model studies, *Lake evaporation, *Evaporation, Lakes, Mathematical models, Maps, Temperature effects, Humidity, *Climatic data, Water loss.

A numerical model and an evaporation map were used to determine mean annual evaporation estimates for 30 lakes. The map used had been derived from a computer model with contour lines showing average annual lake evaporation in the southeastern United States which had been superimposed on a map that was created using 10 year average values of pan evaporation and related meteorological data along with observed evaporation from 10 lakes. The evaporation map thus produced provides annual evaporation estimates that are more consistent with observations than those determined by use of the numerical model. The map cannot provide monthly estimates, however, and is only available for the contiguous United States. The numerical model can provide monthly estimates for shallow lakes and is based on monthly observations of temperature, humidity, and sunshine duration. (Baker-FRC)
W82-06850

2E. Streamflow and Runoff

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
A. K. Tyagi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243429, Price codes: A02 in paper copy, A01 in microfiche. Report, December 1981. 18 p, 3 Fig, 25 Ref. OWRT A-103-OKLA(1), 14-34-0001-1138.

Descriptors: *Streamflow forecasting, *Model studies, *Model testing, *Routing, *Finite element models, Forecasting, Prediction, Projections, Mathematical studies, Flow index, Diversion, Discharge capacity, Discharge coefficient, Flow discharge, Flow measurement, Computer models, Mathematical models, Mathematical analysis.

Application of finite element (FE) methods to unsteady flow equations is presented for predicting depth, velocity, and volume flow rate in a stream. Two simplified FE models (the explicit and weighted-implicit FE models) are proposed as methods appropriate to streamflow routing. The equation of continuity (conserving the mass of flow) is completely retained; the equation of momentum (conserving the flow momentum) is modified to account only for the friction and gravity terms. This study sought to develop an efficient simple model capable of accurately predicting discharges with little or no computational problems; the weighted-implicit model was developed and tested for this purpose for a flood routing problem. The flood hydrograph results obtained from testing both FE models agree closely with a previously-found solution. The weighted-implicit FE model was determined to yield accurate results, with a maximum time interval of 10 minutes and a weighting factor in a range of 0.55-1.00. Delineation of the mass and momentum conservation equations for the overall mathematical model is provided. (Zielinski-MAXIMA)
W82-05918

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. C. Lazaro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243502, Price codes: A11 in paper copy, A01 in microfiche. PhD Thesis, Fall, 1981. 212 p, 28 Fig, 16 Tab, 94 Ref, 2 Append. OWRT B-201-COLO(2).

Descriptors: *Streamflow forecasting, *Water use efficiency, *Computer models, *Management planning, *Operating policies, Streamflow, Planning, Water demand, Water supply, Model testing, Model studies, Forecasting, Water conservation, Water requirements, Simulation analysis, River basin development, Prediction, Flow discharge.

Due to increased competition for available water supplies in the western U.S. and political and financial considerations that new water supply development, recent attention has been focused on more effective operations to enhance water supply and use efficiency. A package of computerized management models is offered for monthly operational planning of complex water resource systems supplied by snow-fed streams. The three basic parts of the package consist of: a state-space water supply forecasting model (accounting for future streamflow uncertainties); a methodology for treating substantially different streamflows; and a river basin management model having simulation and optimization capabilities. Model perameters, forecasts, and the resultant operational plan can be adaptively updated as new information is obtained in real-time. The forecasting model is based on historical patterns identified from derived monthly streamflow records; forecasted monthly streamflow serves as an input to the river basin management model to simulate water storage and system flows. The Cache La Poudre river basin in north-central Colorado was used as the case study to show capability and use of the management package. Package application reduced waste surface water leaving the system. System outflow reduction is dependent on the reservoir maximum safe storage volume and the minimum amount that can be wasted or no longer diverted for storage. (Zielinski-MAXIMA)
W82-05926

STATISTICAL FLOOD FLOW ESTIMATION,
E. Reinius.
Nordic Hydrology, Vol 13, No 1, p 49-64, 1982. 5 Fig, 8 Tab, 9 Ref.

Descriptors: *Flood frequency, *Graphical methods, *Frequency analysis, *Frequency distribution, Mathematical studies, Graphical analysis, Flood peak, Probability distribution, Mathematical equations, Flood discharge, Flood flow.

When the frequency analysis of flood flows is calculated by the grapical method of plotting on probability paper the results obtained are different from results calculated by the analytical method. If both methods were correct, the position should coincide with the mean of the probabilities which the observation of a rank has in a great number of samples, each with the same size. A study using synthetic samples demonstrated that these positions do not coincide with the line of population. Another study indicated that the positions of the probabilities of the expected-mean-values of the largest observation coincide with the line of the population. It was therefore concluded that the logarithm of the annual peak flows should obtain a plotting probability equal to the probability of the expected value of the logarithm of the observations. A new plotting position formula based on these observations is derived. (Geiger-FRC)
W82-05945

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,
Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
C. P. R. Roberts, and W. J. R. Alexander.
Civil Engineer in South Africa, Vol 24, No 1, p 17-21, 24, 25, 27, January, 1982. 16 Fig, 5 Tab, 4 Ref.

Descriptors: *Floods, *Urban areas, Metropolitan areas, Laingsburg, *South Africa, Flood plain zoning, Floodwater, Historic floods, Flood damage, Flood control, Planning, Flood profiles.

The objective of this paper is to highlight the circumstances of the Laingsburg flood, South Africa 1981, which aggravated the loss of life and damage and the considerations which were taken into account in establishing the re-development line for the town. General conclusions drawn from these events are applicable to urban development on flood plains. Laingsburg is situated about 230 km northeast of Cape Town on the banks of the Buffels River, which flows in a southerly direction to join the Touws River, forming the Groot River, eventually turning into the Gouritz River. The Floriskraal Dam is located 20 km downstream of Laingsburg and was completed in 1957. The flood caused the loss of much property and 90 lives. Damage resulted from a combination of a number of aggravating circumstances. The flood arose from a typical black south-eastern weather situation and was estimated to be one of the largest recorded in South Africa, taking the size of the catchment area into account. Aggravating circumstances included the location of Laingsburg itself; the effect of tributary rivers; demolition and scour effects of the flood waters; the deposition of sediment particularly nearest to the enlarged river channel, where there is a rapid decrease in the velocity of the flowing water; floating debris which caused much damage in the town; and structural collapse of many buildings due to high water lovels alone. The effects of bridges across the Buffels River were a problem, as the flood size was 4 to 6 times greater than the size of the flood that would normally be taken into account for the design of road and rail bridges. The primary factor causing the high loss of life was that people could not anticipate that the water would reach such high levels, as there was no historical precedent for this. (Baker-FRC)
W82-05997

THE USE OF RIVER FLOW DATA TO PREDICT LOW FLOWS AS AN AID TO TROUT FARM MANAGEMENT,
Anglian Water Authority (England).
J. W. East, and T. F. Colesc.
Fisheries Management, Vol 13, No 1, p 11-17, 1982. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Streamflow forecasting, Fish, *Low flow, Forecasting, *Trout, Hydrographs, Flow pattern, Springs.

A method for predicting streamflow in groundwater dominated streams allows prediction of low flows several months in advance so that trout farm management may be improved. Annual hydrographs for Belleau Springs, Lincolnshire, from summer and fall of 1971-77 were analyzed to prepare a master recession curve (discharges vs. time). The master recession curve was positioned over the annual hydrograph at the point where flow measurements began to decline, and the predicted values were read. Since it is assured that no runoff or recharge occurs, the estimates are conservative. (Cassar-FRC)
W82-06083

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,

Utah Water Research Lab., Logan.
J. P. Riley, D. J. Chadwick, Jr., L. S. Dixon, L. D. James, and W. J. Grenney.
Water Resources Planning Series UWRL/P-82/02, March 1982. 194 p, 63 Fig, 31 Tab, 79 Ref, 5 Append. 14-06-D-7691.

Descriptors: *Salt uptake, *Salinity, Surface flow, *Overland flow, Model studies, Groundwater movement, Channel efflorescence, Irrigation effects, Simulation, Agricultural runoff, Mountains, Surface runoff, *Utah, *Salt River Basin.

Within the Price River valley, salt enters the river as it is carried by overland flow from natural areas, agricultural drainage, and groundwater inflow entering the stream from natural and man-caused sources. Field and laboratory measurements of process rates for runoff and salt movement were used to develop and calibrate a hydrosalinity model of outflows from the Price River Basin at Woodwide, Utah. The field measurements were specifically used to formulate a model for estimating surface flow in the Coal Creek Basin on the valley floor. The basin simulation assessment model (BSAM) was used to combine local flows and model total outflow from the Price River. As to field data, observed salt loading rates reached 518 lb/sq m daily, groundwater inflow declined steadily throughoout the summer but maintained constant salt concentrations, channel efflorescence varied more than 100 fold with the largest concentrations occurring in saturated bed material, and turbulent mixing and cyclic drying added to salt dissolution rates. Extrapolation of the results with the Coal Creek model showed only a very small percentage of the salt loading from the valley floor to originate from natural lands. BSAM showed average annual salt leaving the Basin at Woodside to be 190,000 tons, 114,000 coming from the mountain area and 76,000 from the valley floor. Of the valley floor contribution, only 3,500 tons are produced by surface runoff from nonirrigated areas. (Moore-SRC)
W82-06093

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
C. O. Ming, and G. H. Nelson.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $14.25, Microfiche $2.00. Geological Survey Open-File Report 81-1054, 1981. 4 Sheets.

Descriptors: *Floods, *Rainfall, *Flood peak, *Flood damage, Flash flood, Streamflow, Discharge measurement, High water mark, Rainfall intensity, Runoff, Historic floods, Hydrographs, Flood profiles, Flood plain management, Maps, *Alabama, Mobile.

Heavy and intense rainfall in the late evening and early morning hours, May 5 and 6, 1981, caused widespread flooding along streams and low-lying areas in the port city of Mobile, Ala. More than 12 inches of rain fell between 6 p.m. May 5, and 3 a.m. May 6. Damage caused by flooding was estimated by the Mobile Department of Public Works to be millions of dollars. Maximum water surface elevations on streams in the area were 2 to 3 feet higher than those that occurred during a similar flood in April 1980. The approximate extent of flooding delineated on maps using flood profiles obtained by field surveys will provide a basis for formulating effective flood plain zoning that could minimize existing and future flood problems. (USGS)
W82-06128

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06133

A STOCHASTIC STREAMFLOW MODEL OF THE PLATTE RIVER AT OVERTON, ODESSA, AND GRAND ISLAND, NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
A. V. Vecchia, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, Colo. 80225, Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1188, 1981. 42 p, 12 Fig, 10 Tab, 9 Ref.

Descriptors: *Model studies, *Streamflow, *Simulation analysis, *Flow characteristics, Evaluation, Monte Carlo method, Time series analysis, *Nebraska, Platte River, Overton, Odessa, Grand Island.

A stochastic model is developed to simulate flows for three seasons (September through February, March and April, May through August) at Overton, Odessa, and Grand Island, Nebraska on the Platte River. The model preserves the first and second order moment properties of the historical flow series, including significant autocorrelations within each station and cross-correlations between the stations. Higher order moments are preserved by a transformation technique that allows the residuals from the model to be approximately normal. An algorithm is given for simulation of combined-stations flows, and some simulations are carried out to determine the likelihood of specified flow shortages that could be detrimental to the wildlife habitat in the reach of the Platte River between Overton and Grand Island. (USGS)
W82-06139

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
L. C. Kjelstrom, and R. L. Moffatt.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $21.25, Microfiche $5.50. Geological Survey Open-File Report 81-909, September 1981. 99 p, 6 Fig, 3 Plates, 1 Tab.

Descriptors: *Flood forecasting, *Distribution patterns, *Frequency analysis, *Floods, Snowmelt, Rainstorms, Storm runoff, Regression analysis, Data collections, *Idaho, Snake River basin, Basin characteristics, Skew coefficients.

Skew coefficients for the log-Pearson type III distribution are generalized on the basis of some similarity of floods in the Snake River basin and other parts of Idaho. Generalized skew coefficients aid in shaping flood-frequency curves because skew coefficients computed from gaging stations having relatively short periods of peak flow records can be unreliable. Generalized skew coefficients can be obtained for a gaging station from one of three maps in this report. The map to be used depends on whether (1) snowmelt floods are domiant (generally when more than 20 percent of the drainage area is above 6,000 feet altitude), (2) rainstorm floods are dominant (generally when the mean altitude is less than 3,000 feet), or (3) either snowmelt or rainstorm floods can be the annual mixi-mum discharge. For the latter case, frequency curves constructed using separate arrays of each type of runoff can be combined into one curve, which, for some stations, is significantly different than the frequency curve constructed using only annual maximum discharges. For 269 gaging stations, flood-frequency curves that include the generalized skew coefficients in the computation of the log-Pearson type III equation tend to fit the data better than previous analyses. Frequency curves for ungaged sites can be derived by estimating three statistics of the log-Pearson type III distribution. The mean and standard deviation of logarithms of annual maximum discharges are estimated by regression equations that use basin characteristics as independent variables. Skew coefficient estimates are the generalized skews. The log-Pearson type III equation is then applied with the three estimated statistics to compute the discharge at selected exceedance probabilities. Standard errors at the 2-percent exceedance probability range from 41 to 90 percent. (USGS)
W82-06142

EVALUATION OF GROUNDWATER RESOURCES IN TOKAR DELTA, SUDAN,
Khartoum Univ. (Sudan). Dept. of Geology.
M. T. Hussein.
Hydrological Sciences Bulletin, Vol 27, No 2, p 139-145, June, 1982. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Aquifers, *Water resources development, Tokar Delta, *Sudan, Deltas, Water quality, Water supply, Water supply development.

Groundwater resources in Tokar Delta are estimated. The delta is an area lying on the Sudanese coast of the Red Sea. Groundwater occurs in clastic sediments deposited in an arcuate prograding delta in which there are lagoons and barrier islands. It occurs at a depth of 7-9 meters in the upstream part of the delta, at 10-12 meters in the center and at 3-6 meters in the downstream portion of the delta. The general flow is paralled to the direction of the surface flow. Main recharge is from the waters of the Khor Baraka and other small ephemeral streams. The hydraulic gradient obtained averages 0.002. The wide range of transmissivity values reveals the heterogeneous nature of the sediments. The storage coefficient varies from about 0.003 in the lagoonal zones to 0.26 in bsrrier islands and upstream sediments. The hydrodynamic data are characteristic of an uncconfined aquifer in the upstream portion of the delta that fingers downstream in semi-confined conditions. As concerns water quality, Tokar Delta is divided into four zones: A fresh water zone, a transitional zone, a zone of sea water intrusion, and a low yield lagoonal zone with poor quality water. The quantity of water that can be safely exploited is 5,5200,000 cubic meters/year. (Baker-FRC)
W82-06197

GROUNDWATER AND MELTWATER IN THE SNOWMELT INDUCED RUNOFF,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Hydrological Sciences Bulletin, Vol 27, No 2, p 147-158, June, 1982. 8 Fig, 10 Ref.

Descriptors: *Groundwater, *Snowmelt, Streamflow, LRunoff, Melting, Basins, Catchment areas.

Various snowmelt-induced runoff processes are discussed. The influence of the diurnal snowmelt cycle on the runoff from basins of different type is analyzed. Through the analysis of measured hydrographs it is shown that conclusions about the origin of streamflow can be drawn from these anlyses. The study concludes that the low in small streams originates from groundwater and overland flow, with the ratio between the two different kinds of flow depending on basin characteristics. The character of the two flows is very different. The discharge in a stream in a basin which is dominated by overland flow follows the diurnal snowmelt fluctuations and is high from the first day of snowmelt. Streamflow originating from groundwater also reacts to snowmelt fluctuations, but the fluctuations are small, and the mean daily flow is increasing during the snowmelt period. One analyzed discharge hydrograph of a stream draining a small watershed has such a character that the streamflow in the first phase of the snowmelt period must mainly originate from overland flow from a large open meadow. In the final phase of the snowmelt period the streamflow is mostly due to groundwater flow recharged on a forested area, but overland flow also constitutes an important part of the total runoff. (Baker-FRC)
W82-06198

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,
Universidad Simon Bolivar, Caracas (Venequela)> Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, and L. A. Escobar.
Hydrological Sciences Bulletin, Vol 27, No 2, p 129-137, June, 1982. 5 Fig, 13 Ref.

Descriptors: *Drainage density, *Kinetics, Climates, Geomorphology, Basins, Hydrology, Streamflow, Runoff, Catchment areas.

The link is explored between the potential energy of the effective rainfall and the kinetic energy of the streamflow at the outlet of a basin. As water from rainfall flows downstream it will convert its potential energy into kinetic energy and friction loss or heat. The kinetic energy thus generated is the tool with which the flow can carve the channels forming the drainage network. Hence, the energy losses in a stream network should have a determining effect on the structure of the network. The lower the kinetic energy at the outlet for a given potential energy, the larger is the energy expenditure inside the basin and the larger one may expect to find the drainage density. This analysis shows that the drainage density cannot be analyzed on the basis of climate alone and that it is necessary to take into account the response characteristics of the basin in any spatial or climatic study of drainage densities. It appears that an energy expenditure framework may be a fruitful approach to providing a more concrete and objective understanding of climatic and geographical variation of the drainage densities of river basins. (Baker-FRC)
W82-06199

RELATIONSHIP BETWEEN THE YEARLY MAXIMA OF PEAK AND DAILY DISCHARGE FOR SOME BASINS IN TUSCANY,
Florence Univ. (Italy).
P. Canuti, and U. Moisello.
Hydrological Sciences Bulletin, Vol 27, No 2, p 111-128, June, 1982. 9 Fig, 2 Tab, 47 Ref.

Descriptors: *Basins, *Flood discharge, Discharge measurement, *Tuscany, Hydrology, Hydrologic models.

This paper deals with the estimation of the probability distribution of the yearly maximum of the peak discharge Q by means of the distribution of the maximum of the daily discharge q and the distribution of the ration R=Q/q. Data for the study related to a group of basins in Tuscany. It was found that the parameters of R can be expressed as a function of basin order, mean altitude, basin magnitude, basin relief, circularity ration and channel slope. In the case where basin order and magnitude, which are difficult to determine, should not be taken into account, the parameters of R can be expressed as a function of mean altitude, relief ratio, circularity ratio, length and basin relief. It is possible also to obtain satisfactory results by assigning constant values, equal to the mean values observed for the basins taken into consideration, to the parameters of R. Basin area did not appear to be one of the most strongly determining geomorphic parameters. However, the distribution of R is affected by the basin size through such parameters as basin magnitude or basin length. The parameters characterizing the distribution of Q can then be worked out as a function of the parameters of q and the parameters of R. Discharge values with pre-set return period obtained in this way show a satisfactory agreement with the values directly derived from a statistical analysis of the observed values; the errors are on the order of 20%. (Baker-FRC)
W82-06200

ROBUST FLOOD FREQUENCY MODELS,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 315-324, April, 1982. 1 Fig, 11 Tab, 28 Ref.

Descriptors: *Floods, *Flood frequency, *Mathematical models, *Simulation, *Estimation, Flood data, Statistical analysis, Probability distribution, Field investigations, Historical flood data.

The concept of a robust model is explored and possible robust flood frequency models are identified. A robust model is one which can produce reliable predictions. Such models possess at least two properties, resistance and efficiency. Resistance is the ability to estimate extreme events; it is desirable in situations where assumptions of the model are uncertain. In flood frequency models the normal distribution produces more resistant estimators than do other distributions. Efficiency refers to sampling variation. Efficiency can be improved by reformulating the model problem or by extending the data base; it is often improved by combining regional and site-specific data. Various simulation studies using Wakeby distributions were conducted. The resistances of various regional and site-specific estimators were examined. Results suggest that the two-parameter log normal distribution approximates the Wakeby distribution for return periods up to about 200 years; it is both most resistant and efficient. The gumbel procedures employing either maximum likelihood or probability-weighted moments displayed comparable resistance. It was observed that site-specific estimators become more preferable as site record length increases. (Titus-FRC)
W82-06319

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 1. DEVELOPMENT OF THE MODEL,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 383-398, April, 1982. 4 Fig, 25 Ref. OWRT B-112-IND.

Descriptors: *Flood peak, *Flooding, *Statistical analysis, *Mathematical models, *Seasonal variation, Discharge, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, Poisson ratio, Turkey.

The flood peak occurrences at a river cross section may be treated as a two-dimensional stochastic counting process in the time-discharge plane. Statistical and conceptual analyses were performed on the flood peaks data of the Karahacili station on the Goksu River in Turkey. A two-dimensional nonhomogeneous stochastic trigger model for the flood peaks is developed in terms of its univariate, bivariate, and multivariate probability generating functions. The first and second theoretical moments and the theoretical one- and two-dimensional probability mass functions of the flood peak counts in the time-discharge plane are derived from the probability generating functons. First, the flood trigger mechanism is modeled as a Poisson process, based on the assumption that flood peaks in non-overlapping time intervals are independent events. Then, flood peaks are modeled as a function of time, starting time, and discharge. Trigger models are appealing because they require minimal computation. (Titus-FRC)
W82-06325

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 2. APPLICATION OF THE MODEL TO THE FLOOD PEAKS OF GOKSU-KARAHACILI,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 399-411, April, 1982. 3 Tab, 9 Fig, 4 Ref. OWRT B-112-IND.

Descriptors: *Flooding, *Flood peak, *Statistical analysis, *Mathematical models, Discharge, Seasonal variation, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, *Xurkey, Goksu River, *Stochastic process.

The stochsatic trigger process is applied to the flood peaks data of the Karahacili gaging station on the Goksu River, Turkey, for several flood seasons. The flood peak process in each flood season is treated as a transient stochastic process which starts at the beginning of the season and ends at the end of the season. In the selection of the time boundaries of the flood seasons the basic criterion is that the stochastic structure of the flood peaks must be roughtly time-homogeneous within a flood season. Also, for statistical computation convenience the time sampling interval is 15 days, so the length of seasons should be a multiple of 15 days. For each season, the thoeretical two-cimensional probability mass function of the variable discharge exceedence level is calculated from the calibrated trigger model. Goodness of fit of the model is tested with the chi square criterion. In all of the seasons examined, the model passed the goodness of fit test at the 5 per cent significance level. This corresponds to a river stage that is 1 meter above the river bank stage on the Goksu. (Titus-FRC)
W82-06326

DISPERSION IN MOUNTAINOUS NATURAL STREAMS,
Sarajevo Univ. (Yugoslavia). Inst. of Water Resources Engineering.
H. Bajraktarevic-Dobran.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 502-514, June, 1982. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Streamflow, *Mountains, Model studies, Mathematical equations, *Turbulent flow, *Path of pollutants, Water pollution sources, *Dispersion.

The mixing of pollutant conservatives in natural, open turbulent mountainous streams was investigated. Considerable turbulency, with relatively limited width and corresponding spatial velocity distribution, make mountainous streams very suitable for the application of the longitudinal turbulent dispersion theory. Tracer study data are used to analyze a simple, relatively accurate and inexpensive method for the calculation of the longitudinal dispersion coefficient in natural open mountainous streams, based on the commonly observed flow parameters. Based on this study it appears that the most convenient methods today for calculating dispersion coefficients in natural and even nonuniform streams are Fischer's methods; the method of flow parameters and methods based on tracer study, the routing procedure, and the method of variance change. Fischer's method of flow parameters applied to mountainous streams gives dispersion coefficients with predicted accuracy within a factor of 4. It has been discovered that Fischer's other two methods, routing procedure and variance change, when used for mountainous streams also yield the predicted accuracy. Calculating the adjusted time scale by a new expression for characteristic length was seen to be convenient and to yield good results for winding and nonuniform streams, which is convenient for natural mountainous streams as well. If there are a number of mainstreams in a cross section, this should be considered when establishing a time scale. (Baker-FRC)
W82-06357

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,
New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2A.
W82-06384

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,
Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze, and H. Arnold.
Report, 1980. 137 p, 3 Fig, 9 Tab, 23 Ref, 5 Append.

Descriptors: *Streamflow, *Computer programs, *Rainfall-runoff relationships, *Hydrologic data collections, *Digital computers, Rainfall intensity, Runoff, Flow rates, Flow measurement, Flow discharge, Flow, Precipitation intensity, Rainfall index, Data collections, Data interpretation, Hydrologic data, Computer models.

Procedures are described for the reduction of data contained on rainfall and streamflow recorder charts, and subsequent routine rainfall/streamflow data analyses. Flow charts and the computer program listings concerning data analyses are present-

ed. Rainfall records reduced by the break-point digitizing procedure are processed in monthly data batches by the program RAINX which outputs one or more of six options (a master file; daily, hourly, and quarter-hourly rainfall summaries; the 24-hour rainfall distributiion; and extreme rainfall intensities). The six options are described, followed by a review of the RAINX program structure as an introduction to the detailed flow charts and program listings of RAINX and its subroutines. Streamflow records digitized by the break-point procedure are processed by the program RUNOF which out-puts one or more of three options (a master file; storm hydrograph data; and a daily summary of streamflow variables). As with RAINX, the output options and a review of the RUNOF program structure, flow charts, program listings and subroutines are described. The digitizing programs, CDPROC, is also delineated, along with its program listing. While the three computer programs are already versatile in their present forms, their refinements based on experience and specific applications are an ongoing process. (Zielinski-MAXIMA)
W82-06386

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,
London Coll. (New Zealand). Dept. of Agricultural Engineering.
T. R. H. Davies.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 343-360, March, 1982. 6 Fig, 42 Ref.

Descriptors: *Classification, *Flow channels, *Streambeds, Alluvial channels, Physical properties, Sedimentation, Erosion, Streamflow, Low flow, Bedforms, Dunes, Ripple marks, Sedimentary structures.

There is at present no generally accepted explanation for the occurrence and behavior of lower flow regime bedforms, in spite of the many field, laboratory, and theoretical investigations addressing this problem. This lack of understanding of bedform processes presents a major obstacle to the development of rational solutions for sediment problems. The use of systems of bedform classification which are qualitative in nature has thwarted efforts to test quantitative theories of bedform behavior. A more quantitative basis for the description of bedforms, which is based on consideration of the effect of water flow on the shape and size of bedforms, is suggested. This classification system identifies three orders of bedform size (Small, medium, and large) and three bedform shapes (Sharp-crested, flat-crested, and flat), which give rise to seven possible types of bedform. The predictions of this analysis were found to be in agreement with data from a variety of sources relating bedform characteristics to mean flow depth and velocity. This classification system appears to provide a consistent framework by means of which bedforms in widely different circumstances can be interrelated. The system also suggests logical explanations for several previously puzzling aspects of bedform behavior, such as ripples on dunes. Further research is needed to develop more precise divisions among the seven forms and to test critically, and perhaps modify, previously developed models of bedform behavior. (Carroll-FRC)
W82-06421

ACCURACY CRITERIA IN DIFFUSION ROUTING,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-06423

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06427

CARRYING CAPACITY OF FLOOD PLAINS,
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik, and M. Demissie.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 443-452, March, 1982. 6 Fig, 21 Ref.

Descriptors: *Flood plains, *Carrying capacity, *Flow channels, Flood flows, Streamflow, Flood discharge, Flood frequency.

Field measurements during floods in several natural channels were analyzed to determine the distribution of flow in the main channel and in the flood plains. The carrying capacity of the flood plains was found to vary from a few percent to more than 80% of the total flow for the floods analyzed. Major factors determining the carrying capacity of the flood plains were the size, shape or form, width, depth, and nature of the flood plains and the main stream and the frequency of the flood event. The carrying capacity of the flood plain was found to increase with increases in the return period of the flood event. The flood plains act as a combination of conveyance channel and storage reservoir during low flood events. However, the flood plain and the main channel appear to behave as a single unit carrying a proportionate share of the discharge during flood events with return periods of 40 years or more. The character of the flood plains appears to change from a storage channel to a conveyance channel as flood events increase in magnitude. (Carroll-FRC)
W82-06428

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr., G. L. Achtemeier, S. D. Hilberg, H. V. Knapp, and R. D. Olson.
Illinois Department of Energy and Natural Resources, Report of Investigation No 102, 1982. 13 p, 39 Fig, 28 Tab, 46 Ref.

Descriptors: *Drought, *Water shortage, *Climatology, *Water levels, *Hydrology, Climactic data, Water costs, Evapotranspiration, Weather, Groundwater, Precipitation, Streamflow, Water supply development, Water supply systems, Weather data collections, Planning.

This report focuses on the hydrlogic, meteorologic, and climatological aspects of the 1980-1981 drought. An important goal of the study was to provide information necessary for future institutional planning and actions to handle future Illinois droughts. This drought, the severest since the early 1950s, was most intense in the southwestern and extreme southern sections of Illinois. These areas had the lowest precipitation, highest temperatures, and greatest departures from normal wind speeds, which produced the state's greatest evaporation and transportation values and subsequent low streamflows and groundwater deficiencies. Five general societal and economic impacts were revealed: 1) increased costs of water and water-related activities, decreased crop yields and land values, and increased costs to ship farm products; 2) increased energy consumption and adverse effects on the area's natural resources; 3) effects on human behavior, i.e., anxiety about finding and conserving water, and a reduction in recreational activities; 4) additional direct and indirect costs to government; and 5) some benefits, i.e., improved and/or larger and better water supply systems. This research has lead to four general recommendations. The first is to develop better informed and organized local and state programs for addressing droughts. The second recommendation is to renovate older water supply systems. The third relates to water conservation, water reuse, and higher water prices. The last recommendation is to develop and use new technologies to help increase water supplies and to aid in better water management. (Atkins-Omniplan)
W82-06523

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,
Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
B. P. Sangal.
National Hydrology Research Institute, NHRI Paper No 16, IWD Technical Bulletin No 122, 1981. 242 p, 6 Fig, 7 Tab, 5 Ref.

Descriptors: *Mean daily flows, *Peak flow, *Flow rates, *Fuller's method, *Langbein's method, *Ontario, Streamflow foredasting, Hydrographs, *Data collections, Statistical Analysis.

A practical method has been suggested for estimating peak flow. The method uses variables that are the mean daily flows of three consecutive days, with the maximum mean daily flow occupying the middle position. A parameter, the value of which lies etween zero and two, is designated as base factor K and has a governing influence on the estimated peak. The predicting formula employed assumes that the K value is equal to one. The method has been applied to streams in Ontario, involving a total of 387 stations equipped with recording gauges, the drainage areas of which vary from less than 1 sq km to more than 100 000 sq km. The number of instantaneous peak data available was 3946 in the period of record ending in 1979. About 57% of the predicted peaks lie within plus or minus 10% and about 79%, within plus or minus 20% of the actual values. About 62% of the peaks have been overpredicted. The parameter K must be estimated for rainfall floods occurring on small streams; its value will generally be less than one for such cases. Some methods are suggested for its estimation. (WATDOC)
W82-06568

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,
Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5B.
W82-06569

CALIBRATING A MOUNTAIN WATERSHED IN WYOMING,
Wisconsin Univ., Stevens Point. Coll. of Natural Resources.
N. E. Spangenberg.
Water Resources Bulletin, Vol 18, No 1 p 133-134, February, 1982. 2 Tab, 5 Ref.

Descriptors: *Calibrations, *Watersheds, *Mountains, Regression analysis, Mathematical studies, Streamflow, Small watersheds, *Wyoming.

Although all investigators who have studied the problem of watershed calibration agree that a minimum pretreatment period is necessary for reliable analysis, in some cases management plans necessitate the use of very sparse existing data as pretreatment information. The calibration of a mountain watershed in Wyoming under such conditions is reported. Imminent timber harvesting forced calibration on the basis of stream flow records for a 5-year period, precipitation data for 10-year period, and stream flow data for another watershed for a 15-year period. Regression equations were tested using the noncentral 't' and associated power graphs to calculate the probabilities of detecting a real difference of 15% of the mean annual flow given the pre and post treatment time periods likely to be available during management. The data suggest that if the Walnut Gulch trapezoidal flume previously used to measure the basin can be reactivated, and if stream flow measured values after treatment are consistent with values before treaatment, it will be possible to detect a 15% difference in flow. The longer the calibration period, the higher the probability of detecting a real difference in flow. (Carroll-FRC)
W82-06583

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06671

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,
Geological Survey, MS. Water Resources Div.
L. B. House.
Geological Survey Open-File Report 81-1192 (WRI), December 1981. 25 p, 4 Fig, 1 Plate, 10 Tab, 5 Ref.

Descriptors: *Streamflow, *Water quality, *Preimpoundment, *Postimpoundment, Reservoirs, Water temperature, Dissolved oxygen, Model studies, Aquatic weeds, Nuisance algae, Chemical analysis, *Wisconsin, Augusta, Bridge Creek watershed.

This study documents streamflow, temperature, and water-quality conditions of a small stream and evaluates the potential effects of a proposed small shallow impoundment. The study was made in cooperation with the Wisconsin Department of Natural Resources. Streamflow and water-quality data were obtained for the 1980 water years. The average streamflow was 45.5 cubic feet per second. The average summer water temperature was 21.0 C, and the average summer dissolved-oxygen concentration was 7.1 milligrams per liter. Computer models were used to simulate the effects of the proposed impoundment on downstream temperature and dissolved oxygen. The simulated average summer downstream temperature rose to 22.5 with a surface-level outlet from the impoundment, and 21.9 C with a bottom-draw outlet. Dissolved oxygen exceeded 6.0 milligrams per liter in both cases. (USGS)
W82-06677

EFFECTS OF FLOODING UPON WOODY VEGETATION ALONG PARTS OF THE POTOMAC RIVER FLOOD PLAIN,
Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Available from Distr. Branch, USGS 604 S. Pickett St. Alexandria, VA 22304 $3.50. Geological Survey Professional Paper 1206, 1982. 21 p, 18 Fig, 7 Tab, 27 Ref.

Descriptors: *Flood plains, *Flood damage, *Vegetation regrowth, *Revegetation, Floods, Flooding, Historic floods, Channel flow, Flood peak, Flood frequency, Flood recurrence interval, *Potomac river, Washington DC, Hurricane Agnes.

A two-part study along the Potomac River flood plain near Washington, D.C., was undertaken to investigate the effects of flooding upon woody vegetation. Floods abrade bark, damage branches and canopies, and often uproot trees. The first study was of vegetation in five monumented floodplain plots which differed in the frequency and severity of floodflow over a 10-year period. Basal area and survival of trees appears to be related to velocity of floodflow, which in turn is related to flood magnitude and channel shape. However, the effects of flooding also depend on the nature of the flood-plain surface and size and growth habit of vegetation. In the second study, a catastrophic flood after Hurricane Agnes in June 1972 was found to cause large-scale changes in the age, form, and species composition of flood-plain forest below Great Falls, Va. The impact of the flood depended primarily on the flow regime of the river; destruction was greatest in areas exposed to the maximum flood foce, and minimal at sheltered locations. Age determinations from dead trunks and surviving trees suggest that most trees in severely damaged areas started to grow since the last great flood, which occurred in 1952. Trees along sheltered reaches survived several previous catastrophic floods. In addition, species varied in ability to withstand damage from the Hurricane Agnes flood. Least likely to recover were species growing on infrequently flooded surfaces, which may explain, in part, their absence at lower flood-plain elevations. (USGS)
W82-06683

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. Slingerland.
Geology, Vol 9, No 10, 1981, p 491-493. 1 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Hydraulic geometry, *Friction, *Systems analysis, Roughness coefficient, Equilibrium, Stability analysis, Velocity, Bedload, Bedload discharge.

An example of how stability analysis can be used to analyze partially specified geologic systems is presented. A partially specified system is one in which the direction of feedback is known, but the exact functional relationships are not. The example presented is an analysis of the response of a stream's hydraulic geometry to disturbance. Five variables with various positive and negative feedback loops specify the system. The variables include stream velocity, friction, hydraulic radius, bedload transport rate, and bed slope. The system's response to perturbation is described by analyzing the eigenvalues derived from the coefficient matrix of the system equations evaluated near an equilibrium point. When applied to the example, this process predicts that the stream is metastable provided that the rates of change of the friction factor, hydraulic radius, and slope are highest, intermediate, and lowest, respectively. Streams violating this ranking are unstable. (Titus-FRC)
W82-06717

MICROBIAL DYNAMICS OF AN EPILITHIC MAT COMMUNITY IN A HIGH ALPINE STREAM,
Montana State Univ., Bozeman. Dept. of Microbiology.
T. K. Haack, and G. A. McFeters.
Applied and Environmental Microbiology, Vol 43, No 3, p 702-707, March, 1982. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Microbiological studies, *Alpine regions, Cold regions, Mountains, Orography, Streams, Bacteria, Algae, Lakes.

The seasonal dynamics of an epilithic algal-bacterial mat community are described, the trophic complexity of which was greatly reduced because of the highly oligotrophic nature of the stream. The study site was the outlet stream of Pine Creek Lake, an alpine cirque lake situated at 2,740 meters in the Absaroka mountains. The lake is fed primarily from springs and snow runoff and is surrounded almost entirely by rock, with little vegetation present in the drainage area. The slippery surface properties of the mat community suggested that extracellular polymeric material was one major component. The mat consisted primarily of diatoms, bacteria, and some filamentous algal forms, all embedded with a dense gelatinous matrix. Water temperature rose from 1.5 to 13 degrees C during the study period. Due to the short duration of warm weather, the mat was active only a few months out of the year. The growth of the phototrophic community peaked at the same time of year as did stream water temperature. All aspects of bacterial heterotrophic activity showed dramatic increases with seasonal progression, indicating maximal uptake rate of a given substrate by the population. The heterotrophic bacterial population in the mat responded to a decline in the phototrophic community with higher catabolic rates. These rates may have increased in response to quantitative or compositional changes in the soluble organic compounds excreted by the phototrophs as their population was waning. However, bacterial consumption rates were highest when primary productivity was lowest, indicating that bacteria were substrate limited at this time of the season with respect to algal extracellular products. It is likely therefore that the accelerated bacterial catabolic activity was triggered in response to an accumulation of algal lysis products. (Baker-FRC)
W82-06729

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 4A.
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 4A.
W82-06855

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,
Geological Survey, Sacramento, Calif. Water Resources Division.
For primary bibliographic entry see Field 4A.
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,
Geological Survey, Denver, Colo. Water Resources Division.
T. R. Eschner, R. F. Hadley, and K. D. Crowley.
Open-File Report 81-1125, 1981. 57 p. 14 Fig, 5 Tab, 61 Ref.

Descriptors: *Surface water, *Streamflow, *Alluvial channels, *Channel morphology, Water use, Vegetation effects, Flood peak, Flow characteristics, Flow duration, Low flow, Wildlife habitats, *Colorado, Nebraska, Platte River basin.

The channels of the South Platte River in Colorado and Nebraska and the North Platte and Platte Rivers in Nebraska have undergone major changes in hydrologic regime and morphology since 1860. These changes are attributed to agricultural, municipal, and industrial water use. Diversion and storage of water have changed streamflow patterns throughout the basin. At some stations, significant changes in flood peaks, annual mean discharges, and shapes of flow-duration curves have been observed. Changes in streamflow patterns are manifested by changes in morphology of channels of the Platte River. Prior to water development in the 19th century, the Platte was a wide (2 kilometers), shallow (1.8 to 2.4 meters) river characterized by bankfull spring flows and low summer flows. The width of the Platte River in 1979 ranged from 8 to 92 percent of the channel width in 1860, increasing in a downstream direction. Above the confluence with the Loup River, overbank flows evidently have become more common. Moreover, the annual number of low flow days has increased and the days of no flow have decreased giving the channels a more perennial character. Width reduction has occurred by progressive encroachment of vegetation and consequent vertical and horizontal accretion on sand bars in the channel. (USGS)
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-06947

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 8B.
W82-06948

2F. Groundwater

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
V. V. Palciauskas, and P. A. Domenico.

Water Resources Research, Vol 18, No 2, p 281-290, April, 1982. 5 Tab, 22 Ref.

Descriptors: *Rock mechanics, *Radioactive waste disposal, *Groundwater management, *Thermal pollutiion, *Geologic fractures, Waste management, Resources management, Rock properties, Fluid mechanics, Radioactive wastes, Thermal conductivity, Heat transfer, Thermal expansion.

The fluid pressure and mechanical response of a potential nuclear waste repository rock to heating was characterized by isothermal parameters of the classic stress-strain theory for a porous medium plus some nonisothermal parameters describing the fluid, solid, and pore volume expansivities. By formulating the fluid response within the limits of drained and undrained behavior, the isothermal coefficients may be described in terms of more easily interpretable parameters. The ideal repository for nuclear wastes would appear to favor an undrained response within the isolated pores and cracks of a fracture rock medium. Cases of fluid pressure increases in excess of temperature-induced increases under in situ stress, elastic strain and the potential for inelastic crack propagation, and porosity-permeability augmentation are presented. These examples illustrate an irreversible effect of temperature due to the differential thermal expansion of the composite mineral grains and the generation of new grain boundaries. During such a heating event, the increase in porosity may be calculated and is empirically related to increases in permeability. (Geiger-FRC)
W82-05904

INFILTRATION RATES OF RAINWATERS IN SRI LANKA MEASURED BY USING TRITIUM TRACER,
Sri Lanka Univ., Colombo.
J. K. Dharmasiri, K. G. Dharmawardena, M. W. P. Wijesinghe, P. Thiranagama, and I. D. T. De Mel.
Nordic Hydrology, Vol 13, No 1, p 13-27, 1982. 10 Fig, 3 Tab, 11 Ref.

Descriptors: *Radioactive tracers, *Tritium, *Natural recharge, *Rainfall infiltration, *Rainfall-runoff relationships. Tracers, Radioisotopes, Recharge, Infiltration rate, Groundwater recharge, Soil water, Moisture profiles, Geohydrology, Groundwater hydrology, *Sri Lanka.

Some experiments were conducted on top soil of Sri Lanka to study the infiltration rates of rainfall using artificial tritium as a tracer. For two well-established aquifers, Mannar and Vanathavillu, the recharge of groundwater is close to 30%, while the infiltration rate is much higher. Fractional recharge values at Madhu Road sites vary from 15 to 32%. Moisture movement in this area resembles piston flow. In the central highland sections which are covered with fractured rocks overlain by only a few meters of top soil, the rate of infiltration is very high. (Geiger-FRC)
W82-05941

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,
Komenskeho Univ., Bratislava (Czechoslovakia).
I. Mucha, and H. Kaergaard.
Nordic Hydrology, Vol 13, No 1, p 27-38, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Aquifer systems, *Aquifer testing, *Leaky aquifers, *Aquitards, *Drawdown, *Pumping, Model studies, Numerical analysis, Mathematical studies, Confined aquifers, Groundwater movement, Pump wells, Test wells, Aquicludes.

A numerical model was devised for computing drawdowns (resulting from pumping a single well) anywhere in a multiaquifer/aquitard system. Since the model cannot handle inhomogeneities in horizontal directions, it is of a radial, symmetric type. The model has proven useful in studying drawdown evolutions during aquifer tests in stratified geohydrologic systems. It was designed to compute the effects of stratification on the results of pumping tests. In order to understand the behavior of the model, drawdowns in a hypothetical system were computed and compared with standard aquifer test formulas. Application of the model in interpreting two previously reported aquifer tests for Horsens Municipal Water Supply and the Torkildstrup-Lillebraende Waterworks of Denmark showed good agreement of simulated and field results. The model has been especially helpful in revealing the limitations involved with using standard aquifer test formulas in such systems. (Geiger-FRC)
W82-05943

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, and P. Fritz.
Canadian Journal of Earth Sciences, Vol 19, No 4, p 645-661, April, 1982. 8 Fig, 4 Tab, 44 Ref.

Descriptors: *Groundwater, *Chemical analysis, Sudbury Basin, Dating, *Ontario, Canada, Water analysis, Calcium, Sulfates, Sodium, Chlorides, Meteoric water.

A detailed survey was undertaken in 1979-1980 to evaluate the occurrence, chemistry, origin, and genesis of saline groundwaters across the Canadian Shield, with early work focusing on the chemical and isotopic compositions of deep groundwaters from the Sudbury Basin. The Basin is a elliptical body about 60 km long and 30 km across with an east-northeast trending long axis. Several large faults, which extend to considerable depth, intersect many of the rock units along the north edge of the basin. It appears that the faults and dikes, particularly on the north side of the basin, play a major role in the transport and storage of groundwaters at depth. Groundwater samples were obtained from Falconbridge's Fraser, North, and Lockerby mines and INCO's Copper Cliff South and Garson mines. Two very distinctive groundwater types were found. Above 914 meters the waters are of meteoric origin, showing a gradual increase in dissolved load with depth, and seldom exceeded 5000 mg/liter salt concentration. With increasing depth these waters usually showed considerable increase in sodium, calcium, chloride and sulfate, while decreasing in concentrations of magnesium, potassium, and carbonate. The water with a meteoric origin has a considerable volume less than 30 years in age. Highly saline waters and brines were encountered below 914 meters. The brines appear to represent very old, stagnant groundwaters which may have undergone prolonged chemical and isotopic alteration since their original emplacement. (Baker-FRC)
W82-05990

DEVELOPMENT OF PREDICTION EQUATIONS FOR A PHREATIC AQUIFER IN RESPONSE TO INFILTRATION: DIMENSIONAL ANALYSIS,
Mississippi Univ., Oxford. Dept. of Civil Engineering.
S.-Y. Liong, and D. G. DeCoursey.
Water Resources Bulletin, Vol 18, No 2, p 307-310, April, 1982. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Aquifers, *Infiltration, *Dimensional analysis, Subsurface flow, Phreatic aquifers, Streamflow, Prediction, Unconfined aquifers, Groundwater movement.

Dimensional analysis was used to study the response of a phreatic aquifer to infiltration. Relationships between dependent and independent variables were developed in this preliminary work, which provided an understanding of the dependence of subsurface contributions to streamflow on the dimensions of the flow domain, soil properties, infiltration rate and duration, and the initial hydraulic gradient of the water table. This information will be used to develop prediction equations. (Cassar-FRC)
W82-06066

HELIUM ISOTOPES IN GEOTHERMAL SYSTEMS: ICELAND, THE GEYSERS, RAFT RIVER AND STEAMBOAT SPRINGS,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and W. J. Jenkins.
Geochimica et Cosmochimica Acta, Vol 46, No 5, p 739-748, May, 1982. 1 Fig, 6 Tab, 58 Ref.

Descriptors: Geothermal resources, *Helium, Isotope, *Iceland, Groundwater, *Geothermal studies, *Hawaii, *The Geysers, *Raft River, *Steamboat springs, Volcanoes, Volcanic springs.

Helium isotope ratios can be used to evaluate a variety of geologic and hydrologic problems. The helium isotope composition of geothermal fluids is used to evaluate the local tectonic environment in the light of possible overprint mechanisms and to infer a probable source for the thermal anomaly. Geothermal fluids studied were from Iceland, The Geysers, Raft River, Steamboat Springs, and Hawaii. The helium isotope ratios were interpreted in terms of the processes which supply helium in distinct isotopic ratios and in terms of processes which can change the isotopic ratio. Iceland was found to be an area of hot spot magmatic helium, implying an active volcanic source, although data are suggestive of high temperature weathering release of crustal helium incorporated in the geothermal fluids. According to a comparison with fumarolic gases from Hawaii and Juan De Fuca and Cayman Trench Basaltic glass samples, The Geysers contains mid-ocean ridge type magmatic helium, again implying an active volcanic source, possibly a leaky transform related to the San Andreas Fault System. Raft River contains only crustal helium, indicating no active volcanic sources. Steamboat Springs helium isotope ratios are distinctly less than typical plate margin volcanics but must still have a magmatic source. A preliminary assessment of the cause for this low ratio is made, assuming an aging magma source. (Baker-FRC)
W82-06085

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06131

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06135

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06138

GROUND-WATER HYDROLOGY OF STRIP-MINE AREAS IN EASTERN OHIO (CONDITIONS DURING MINING OF TWO WATERSHEDS IN COSHOCTON AND MUSKINGUM COUNTIES),
Geological Survey, Columbus, OH. Water Resources Div.
J. O. Helgesen, and A. C. Razem.
Geological Survey Open-File Report 81-913 (WRI), 1981. 25 p, 14 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater, *Strip mines, *Small watersheds, *Coal mining, Spoil banks, Aquifers, Groundwater movement, Sedimentary rocks, Perched water, Observation wells, Water level, Base flow, Model studies, Water quality, Chemical analysis, Data collections, Hydrographs, *Ohio, Coshocton County, Muskingum County.

Ground-water conditions during coal strip-mining in two small watersheds are described as part of an ongoing study of effects of mining on hydrologic systems. Each watershed was underlain by stratified sedimentary rocks containing two perched aquifers above clays which underlaid the major coal seams. Mining involved removing the overburden rocks, including the top aquifer, stripping the top coal seam, and recontouring the overburden spoils to the approximate premining shape of the watershed. Water-levels in the top aquifer declined as mining neared the watersheds, but destruction of observation wells precluded a record of the decline during mining of the watersheds. Depletion of the top aquifer was reflected in stream base flow, which was reduced and more highly mineralized after mining. Initial saturated thickness of replaced overburden spoils ranged from 0 to 4 feet, based on data from observation wells installed immediately after reclamation. Down-hole specific conductance measurements of water in the spoils suggest the presence of more highly mineralized water than that in the premining top aquifer. No immediate significant effects of mining are evident on groundwater levels or quality beneath the stripped coal. (USGS)
W82-06141

CHLORIDE ION CONCENTRATIONS AS AN AID TO ESTIMATING RECHARGE TO THE WOBURN,
National College of Agricultural Engineering, Silsoe (England).
W. M. Irving.
Quarterly Journal of Engineering Geology, Vol 15, No 1, p 47-54, 1982. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Natural recharge, *Groundwater recharge, *Clays, Mathematical studies, *Chlorine, *Groundwater hydrology, Recharge, Drawdown, *Chlorides, Saline water, Evapotranspiration, Geohydrology, Groundwater movement, Surface runoff, *England, Woburn Sands.

The principal representative of the Lower Greensand on the north side of the London basin is the Woburn Sands, which outcrop in Bedfordshire and Cambridgeshire. Where the outcrop is covered with till, recharge waters contain higher levels of chloride than waters recharged in drift-free areas. This was attributed to higher evapotranspiration rates where the soil is underlain by boulder clay. Localized increases in chloride concentrations ere also noted due to indirect recharge from influent streams and mizing with old saline waters. The average annual natural direct recharge for untilled areas agreed closely with published figures determined by Penman and Grindley's equations. These equations may be used to calculate approximate values for recharge through boulder clay when losses to surface water as runoff and inteflow are taken into account. The amount of indirect recharge from influent streams is also calculated. (Geiger-FRC)
W82-06234

STEADY STATE PERCHED GROUNDWATER MOUNDS ON THICK SUBLAYERS,
California State Univ., Fullerton. Dept. of Civil Engineering.
R. R. Brock.
Water Resources Research, Vol 18, No 2, p 376-382, April, 1982. 2 Tab, 6 Fig, 5 Ref.

Descriptors: *Groundwater, *Permeability, *Perched groundwater, *Aquifers, *Mathematical models, Darcy's law, Profiles, Water table profiles, Recharge basins, Estimating equations, Statistical analysis, Model studies, Groundwater recharge.

Perched groundwater mounds that develop beneath a strip recharge basin are considered using the potential theory for a saturated flow. The mounds are assumed to develop upon an aquitard or sublayer whose thickness is large enough so that the vertical velocity at the base of the mound does not vary with distance from the centerline of the basin. A finite difference technique was used to solve the potential theory, and 20 mound profiles were determined for various permeability ratios and recharge rates. It is found that for a sufficiently large value of the permeability ratio, the Dupuit-Forchheimer theory will accurately predict mound thickness. For smaller values, the equipotential theory must be used. (Titus-FRC)
W82-06317

EVALUATION OF THE GROUNDWATER RESOURCES OF THE AGAG BASIN, SAIPAN,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers.
Technical Report No 31, November 1981. 82 p, 12 Fig, 6 Tab, 20 Ref, 2 Append. S 80-161.

Descriptors: *Groundwater availability, *Groundwater basins, *Groundwater depletion, *Recharge, *Water management, Pumping tests, Permeability, Water level, Water table fluctuation, Water table profiles, Aquifers, Driling samples, Driller logs, Head loss, Monitoring, Water deficit.

The Agag groundwater basin has long been a reliable source of high-quality water. Because little was known about the basin, this study was undertaken to investigate the hydrogeological characteristics of the basin to determine the optimal or sustained yield of the aquifer. Exploratory drilling, water-level monitoring, and analyses of past and current field data were employed. The basin is a three-dimensional mosaic of interbedded and interfingered units of the Tagpochau limestone of Miocene age. Pump-test analyses put the permeability range of the marly facies between 25-70 ft/day. A strong correlation was found between water-table fluctuations and seasonal rainfall, with a ten foot variance between wet and dry seasons not unusual. Water-table data plotted against time (since 1973) indicate a decline of 1.25 ft/yr with the overdraft occurring in the dry season. Annual recharge is about 40-to-46 percent of the yearly rainfall and occurs during wet-season months; none occurs in the dry months. Because recharge is seasonal, two values of sustained yield have been determined: 300,000 gpd in the dry season (January-June) and 600,000 gpd in the wet season. Proper management of the basin requires a stable water-table level so that wet-season recharge will replenish the stored groundwater removed during the dry-season production period. Recommendations include moving one well to overcome interference from other wells, continuation of water-level monitoring, installing piezometers in all production wells, and implementing a two-season pumping schedule. (Atkins-Omniplan)
W82-06524

CALCULATIONS OF THE CAPACITY OF WATER INTAKES WITH CONSIDERATION OF GROUNDWATER LEAKAGE THROUGH STEEPLY DIPPING, POORLY PERMEABLE DEPOSITS,
Moscow Combined Geological and Geophysical Expedition (USSR).
A. M. Prosekov.
Water Resources, Vol 8, No 3, p 336-340, May/June, 1981. 2 Fig, 3 Ref. Translated from Vodnye Resursy, No 3, p 176-181, May/June, 1981.

Descriptors: *Well yield, *Seepage, *Groundwater availability, *Artesian capacity, Geohydrology, Aquifer systems, Capacity, Permeability, Model studies, Numerical analysis, Oka-Tsna arch, Groundwater potential, Mathematical models, Hydrodynamics, *USSR.

The capacity of groundwater intake, considering leakage of groundwater through steeply dipping, poorly permeable deposits, was calculated for the 200 km long crest part of the Oka-Tsna arch, a submeridional positive tectonic structure in the region of the Moscow artesian basins. A linear row of wells at the foot of the arch along its axis intercepts one aquifer, separated from a second aquifer by a poorly permeable clay layer, but receiving some seepage. The results of the calculations more reliably reflected natural conditions than a model with an impermeable boundary or an inhomogeneous bed. (Cassar-FRC)
W82-06617

LINEAMENTS AND FRACTURE TRACES, JENNINGS COUNTY AND JEFFERSON PROVING GROUND, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
T. K. Greeman.
Geological Survey Open-File Report 81-1120, December 1981. 17 p, 3 Fig, 1 Plate, 16 Ref.

Descriptors: *Geological fractures, *Groundwater availability, *Water demand, *Aquifer characteristics, Wells, Drilling, Water yeild, Bedrock, Groundwater movement, Potential water supply, Maps, *Indiana, Jennings County, Jefferson Proving Ground, Lineaments, Fracture traces.

Location of vertical or near-vertical bedrock fractures observed throughout the study area in Indiana are shown on a lineament and fracture trace map. Wells drilled on these mapped features may yield adequate supplies for domestic use. Large yields may be available in southwest Jennings County. Two nearly horizontal sequences of middle-Paleozic limestone and dolomite, separated by a thin discontinuous shale unit, constitute the prinicpal aquifer. Many wells in this aquifer fail to supply household needs, whereas others supply several households. All wells in the aquifer have been located for the owners' convenience and are randomly located in relation to lineaments and fracture traces. Pleistocene drift, averaging 25-30 feet in thickness, did not restict lineament nad fracture-trace mapping. Well placement is important in this area, as fractures are a principal source of water to wells. In fractured bedrock areas, the most productive wells are at mapped lineament or fracture-trace intersections and at the lowest local altitude. Use of the lineament and fracture-trace map will not guarantee a sufficient ground-water supply, but it will minimize the chance of drilling an inadequate well. (USGS)
W82-06675

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06676

SUMMARY OF HYDROLOGIC TESTING IN TERTIARY LIMESTONE AQUIFER, TENNECO OFFSHORE EXPLORATORY WELL--ATLANTIC OCS, LEASE-BLOCK 427 (JACKSONVILLE NH 17-5),
Geological Survey, Atlanta, GA. Water Resources Div.
R. H. Johnston, P. W. Bush, R. E. Krause, J. A. Miller, and C. L. Sprinkle.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2180, 1982. 15 p, 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater, *Test wells, *Confined aquifers, *Geochemistry, Geohydrology, Geohydrologic units, Limestone, Drilling, Continental shelf, Saline-freshwater interfaces, Data collections, *Atlantic outer-continental shelf, Drill-stem tests.

A summary of hydrologic testing in an offshore oil-test well drilled for Tenneco, Inc. 55 miles east of Fernandina Beach, Fla., is presented. The interval tested (1,050 to 1,070 feet below sea level) is in a calcarenite that is equivalent to the Ocala Limestone (late Eocene) of onshore Florida and South Georgia. Onshore the Ocala forms the highly productive Tertiary limestone aquifer system of the southeastern United States. Pressure-head measurements indicate an equivalent freshwater head of 24 to 29 feet above sea level. This pressure-head measurement and an earlier one made in the nearby JOIDES J-1 hole are the only hydraulic head determinations to date in the offshore extensions of any of the aquifers underlying the Atlantic Coastal Plain. The drill-stem test recovered water samples containing about 7,000 milligrams per liter chloride. However, seawater used in the drilling process apparently contaminated the samples and the

formation water is considered slightly fresher. The head and salinity data from the Tenneco well suggest that the sampled interval lies in the transition zone between fresh and seawater in the limestone aquifer. These data, when viewed with similar data from JOIDES J-1, show the transition zone to the slope very slightly landward. Heads at both wells are compatible with the onshore flow system as it existed prior to development. (USGS)
W82-06685

GROUND WATER IN THE PIEDMONT UPLAND OF CENTRAL MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
C. A. Richardson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2077, 1982. 42 p, 7 Fig, 7 Tab, 28 Ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater availability, *Geohydrology, Aquifer characteristics, Water table, Wells, Water yield, Water quality, Water use, Water supply, *Maryland, Maryland Piedmont.

Aquifers in a 130-square-mile area of the central Maryland and Piedmont, are shown to be the sole or principal source of water. The study area is underlain chiefly by crystaline rocks and partly by unaltered sandstones and siltstones. The ground water is derived from local precipitation and generally occurs under water-table condtions. Its movement is restricted by the lack of interconnected openings, and most ground water occurs within 300 feet of the land surface. Hydrographs indicate no long-term change in ground-water storage. A few wells yield more than 100 gallons per minute, but about 70 percent of 286 inventoried wells yield 10 gallons per minute or less; most specific capacities are less than 1.0 gallon per minute per foot. The ground-water quality is generally satisfactory without treatment and there are no known widespread pollution problems. Estimated daily figures on ground-water use are as follows: 780,000 gallons for domestic purposes; 55,000 for commercial purposes; and 160,000 for public supply. Although part of the area is served by an existing surface-water supply and could be served by possible extension of those and other public-supply water mains, much of the rural population is dependent on the ground water available from private wells, tapping the single aquifer that underlies any given location. Neither the ground-water conditions nor this dependence on individual wells is unique to the study area, but, rather, applies to the entire Piedmont province. (USGS)
W82-06686

POROUS MEDIA EQUIVALENTS FOR NETWORKS OF DISCONTINUOUS FRACTURES,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. C. S. Long, J. S. Remer, C. R. Wilson, and P. A. Witherspoon.
Water Resources Research, Vol 18, No 3, p 645-658, June, 1982. 12 Fig, 4 Tab, 36 Ref.

Descriptors: *Porous media, *Model studies, Capillary water, Porosity, Soil porosity, Rocks, Rock properties, *Permeability, *Fracture permeability, Groundwater movement, Hydrology.

The theory of flow through fractured rock and homogeneous anisotropic porous media is used to determine when a fractured rock behaves as a continuum. A fractured rock can be said to behave like an equivalent porous medium when there is an insignificant change in the value of the equivalent permeability with a small addition or subtraction to the test volume and when an equivalent permeability tensor exists which predicts the correct flux when the direction of a constant gradient is changed. Field studies of fracture geometry are reviewed, and a realistic two-dimensional fracture system model is developed. The shape, size, orientation, and location of fractures in an impermeable matrix are random variables in the model. These variables are randomly distributed according to field data currently available in the literature. The fracture system models are subjected to simulated flow tests. The results of the flow tests are plotted as permeability ellipses. The size and shape of these permeability ellipses show that fractured rock does not always behave as a homogeneous, anisotropic porous medium with a symmetric permeability tensor. Fracture systems behave more like porous media when fracture density is increased, apertures are constant rather than distributed, orientations are distributed rather than constant, and larger sample sizes are tested. Preliminary results indicate that the use of this new tool will enhance the ability to analyze field data on fractured rock systems. The tool can be used to distinguish between fractured systems which can be treated as porous media and fractured systems which must be treated as a collection of discrete fracture flow paths. (Baker-FRC)
W82-06851

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. Noorishad, and M. Mehran.
Water Resources Research, Vol 18, No 3, p 588-596, June, 1982. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Solute transport, *Mathematical studies, *Porosity, *Porous media, Capillary water, *Finite element method, Groundwater, Geologic fractures, *Fractured porous media.

The problem of two-dimensional transient transport of solutes in fractured porous media is considered using an upstream finite element scheme. The processes of advection, dispersion, diffusion, adsorption, and first-order reaction in the fracture and porous matrix are included in the mathematical model. The numerical algorithm first solves the fluid flow problem in the region of interest and then by an auxiliary finite element routine the nodal point velocities of the continuum elements are determined. This procedure ensures continuity of velocity across element boundaries, and also it is required for implementation of upstream weighting functions. Fracture element velocities are average velocities calculated directly from endpoint pressures. Knowing the fluid flow field, the code then solves the transport equation using its own nonsymmetric solver. A unique feature of this study is the representation of discrete fractures by two-nodal point elements. This facilitates the mesh generation and numbering of the elements as well as enhancing the computation efficiency and reducing the required computer storage. The validity of the numerical scheme was established through comparison with existing one- and two-dimensional analytic solutions. (Baker-FRC)
W82-06858

IDENTIFICATION OF AQUIFER TRANSMISSIVITIES: THE COMPARISON MODEL METHOD,
Milan Univ. (Italy). Inst. of Geofisica.
G. Ponzini, and A. Lozej.
Water Resources Research, Vol 18, No 3, p 597-622, June, 1982. 27 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Aquifer properties, Hydrogeology, *Groundwater, *Transmissivity, Geology, Hydrology, Piezometric head, Mathematical studies, Water resources development, Groundwater management.

A method is presented for solving the inverse problem in hydrogeology. The method is suitable for computing the interblock transmissivities (harmonic mean or others) referred to the sides of the network blocks of a nonhomogeneous, anisotropic aquifer in steady state flow. The interblock transmissivities computing procedure is based on the comparison between real gradients and those generated by a comparison model whose initial transmissivity value is arbitrarily chosen and constant throughout the surveyed area. Alternative solutions of interblock transmissivities, one for each constant initial transmissivity value utilized in the comparison model, are obtained. In general these solutions differ from each other, but all present characteristics of being able to reproduce the real piezometric heads, respecting the geometry and the boundary conditions of the real aquifer. The selection of the value or set of values of the initial transmissivity to put into the permit selection of a value or a set of values of initial transmissivity. These criteria exploit only the data needed for the solution of the inverse problem and lead to a suitable initial transmissivity which allows one to obtain a good and meaningful solution of computed interblock transmissivities. The comparison model method and the two aforementioned criteria have been applied to a numerical case study, giving good results. (Baker-FRC)
W82-06859

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. Soughty, G. Hellstrom, and C. F. Tsang.
Water Resurces Research, Vol 18, No 3, p 571-587, June, 1982, 19 Fig, 1 Tab, 26 Ref.

Descriptors: *Aquifers, *Thermal water, Storage, Aquifer properties, *Thermal pollution, Heated water, Plumes, Thermal power, Hydrothermal studies, Heat, Model studies.

Thermal behavior around a storage well is considered in the case when buoyancy effects can be neglected. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A numerical model using a steady flow field is used to simulate heat transport in the aquifer and confining layers around the injection/production well during the aquifer thermal energy storage (ATES) cycle. The key parameters are varied to understand their influence on the percent of the injected energy that can be recovered and the temperature of the extracted water. The storage volume appeared as a fundamental parameter of the system. The relative heat loss was roughly proportional to the surface to volume ratio. The thermal behavior of the storage system was very sensitive to the value of the effective thermal conductivity in the aquifer. After an initial transient period, the heat loss through the upper surface of the aquifer was determined by the thickness of the cap rock. The cycle is divided into periods of injection, storage, production and rest in accordance with the supply and demand of heat. The relative duration of these periods appears to have a fairly small influence on the recovery factor when the length of the cycle is constant. The recovery factor when the length of the cycle is constant. The recovery factor increased with the number of storage cycles. During each cycle heat was lost to the cold surroundings. The thermal pollution appears to spread out at a rather slow rate when there is no regional flow in the aquifer. The shape of the heated volume should be as compact as possible to minimize the heat loss. (Baker-FRC)
W82-06861

NUMERICAL TREATMENT OF LEAKY AQUIFERS IN THE SHORT TIME RANGE,
Universidad Nacional Autonoma de Mexico. Mexico City. Centro de Investigaciones en Matematicas Aplicadas y en Sistemas.
B. Chen, and I. Herrera.
Water Resources Research, Vol 18, No 3, p 557-562, June, 1982. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Aquifers, *Leakage, Mathematical equations, Model studies, Mathematical models, *Leaky aquifers, Water loss, Permeability.

A procedure is presented which permits the avoidance, to a large extent, of several difficulties in the numerical treatment of leaky aquifers in the short time range. The method is based on the integrodifferential equations approach. A method that can be applied to control the error is also presented. Leaky aquifers are characterized by the fact that the permeabilities of the semipervious layers sepa-

rating the main aquifers are very small. When the difference in permeabilities between the main aquifers and the aquitards is one order of magnitude or more, the flow can be taken as vertical in the aquitards. Attention is restricted to the case of one main aquifer limited above by one aquitard and overlying an impermeable bed. The analysis is applicable, however, to a multiaquifer system in the short time range because in this range the interaction between the main aquifers is not perceptible. Also, if the main aquifer overlies another aquitard, the modification of the arguments is straightforward. (Baker-FRC)
W82-06863

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
A. D. Gupta, and P. N. D. D. Yapa.
Water Resources Research, Vol 18, No 3, p 546-556, June, 1982, 14 Fig, 18 Ref.

Descriptors: *Aquifers, *Saline water intrusion, Model studies, Encroachment, Saline water, Salinity, Brines, Seawater, *Thailand, Bangkok.

A study was undertaken to provide an insight into the mechanism of saltwater contamination based on the phenomenon of hydrodynamic dispersion. An approach considering both analytical and numerical models for assessing the saltwater encroachment phenomenon in an aquifer was found to be quite efficient in field situations with limited information available on salt concentration and parametric variations. A case study of saltwater encroachment in Bangkok, Thailand was used to illustrate this approach in identifying the sources of contaminating water and in evaluating the effectiveness of the water quality monitoring network. The important point to be noted is the advantage of doing a one-dimensional model analysis and a two-dimensional model analysis simultaneously. By this means computing effort will be minimized, and in addition, a proper assessment for the approximation of the parameters can be made. It was concluded that saltwater encroachment in the Phra Pradaeng aquifer does not occur only from the sea. Connate water bodies entrapped in sediments from the time of deposition under marine coditions are predominant in the contamination of fresh water supplies. These bodies are located to the west and southwest of the Chao Phraya River, where the average initial chloride concentration was about 8000 mg/liter. Either vertical leakage of saltwater from the upper aquifer of brackish water content occurs, or some wells from which wate samples had been collected were improperly grouted. Both conditions may have existed. Attempts will be made in Thailand to simulate salt water movement, along with the simulation of the flow regimes. (Baker-FRC)
W82-06864

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer, and D. K. Maurer.
Open-File Report 80-1123 (WRI), 1981. 29 p, 18 Fig, 12 Ref.

Descriptors: *Groundwater, *Geophysis, *Gravity studies, Aluvial deposits, Bedrock, Resistivity, Playas, Water quality, *Nevada, Washoe County, Lemmon Valley, Silver Lake.

Rapid growth in the Lemmon Valley area, Nevada, during recent years has put increasing importance on knowledge of stored ground water for the valley. Data that would fill voids left by previous studies are depth to bedrock and depth to good-quality water beneath the two playas in the valley. Depths to bedrock calculated from a gravity survey in Lemmon Valley indicate that the western part of Lemmon Valley is considerably deeper than the eastern part. Maximum depth in the western part is about 2,600 feet below land surface. This depression approximately underlies the Silver Lake playa. A smaller, shallower depression with a maximum depth of about 1,500 feet below land surface exists about 2.5 miles north of the playa. The eastern area is considerably shallower. The maximum calculated depth to bedrock is about 1,000 feet below land surface, but the depth throughout most the eastern area is only about 400 feet below land surface. An electrical resistivity survey in Lemmon Valley consisting of 10 Schlumberger soundings was conducted around the playas. The maximum depth of poor-quality water (characterized by a resistivity less than 20 ohm-meters) differed considerably from place to place. Maximum depths of poor-quality water beneath the playa east of Stead varied from about 120 feet to almost 570 feet below land surface. At the Silver Lake playa, the maximum depths varied from about 40 feet in the west to 490 feet in the east. (USGS)
W82-06949

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-06952

2G. Water In Soils

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
A. W. Warrick, D. O. Lomen, and P. J. Tonellato.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243528, Price codes: A05 in paper copy, A01 in microfiche. Report, 1981. 78 p, 2 Fig, 6 Tab, 18 Ref, 4 Append. OWRT B-097-ARIZ(1).

Descriptors: *Soil moisture, *Water pollution sources, *Computer programs, *Trickle irrigation, *Numerical analysis, Groundwater runoff, Linear programming, Mathematical studies, Statistical analysis, Algorithms, Experimental design, Water use, Mathematical models, Algorithms, Plant growth, Ecological effects, Simulation analysis, Soil water.

Theory, computer program subroutines, and applications are described which demonstrate ready application of available solutions descriptive of flow from line and point sources. The linearized forms presented are the only analytical (as opposed to numerical) forms currently available, which are relevant to trickle irrigation geometries. The basic approach has been to document ready-to-use FORTRAN programs which can be used, in whole or in part, to give numerical answers. The programs can be directly used without studying their derivations. Applications are illustrated in eight examples appropriate to trickle irrigation, with the data and output presented. The examples range from a steady-state line source, to a cyclical point source with a cylindrical sink to simulate plant water uptake from the soil. Two of the computer programs presented are set up to solve important two- and three-dimensional problems. For cases not covered by these two programs, subroutines are given as a shortcut to compose algorithms needed to compute the solution. Answers are expressed in tabular and plot formats, giving distributions of matric flux potentials and pressure heads. (Zielinski-MAXIMA)
W82-05928

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
For primary bibliographic entry see Field 7B.
W82-05956

A COMPARISON OF THREE INFILTRATION MODELS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
B. N. Wilson, D. C. Slack, and R. A. Young.
Transactions of the ASAE, Vol 25, No 2, p 349-356, March/April, 1982. 3 Fig, 6 Tab, 30 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Model studies, Green-Ampt-Mein-Larson models, Ponding.

The theoretical development and performance of three infiltration models are compared. The models were an unmodified Green-Ampt-Mein-Larson model (GAML-UNMOD), a similar model modified to account for entrapped air (GAML-ETA), and a model which includes air entrapment and air resistance effects (GAML-ART). The GAML-UNMOD model, conceptually the simplest, did not predict time to surface ponding accurately. The errors were probably a result of unmodified saturated hydraulic conductivity values. The GAML-ETA predicted time to ponding reasonable well but greatly overestimated infiltration on wetter soils. The GAML-ART model produced the best overall results but tended to overestimate on wet soils. This problem with overprediction on wet soils may be a result of partial surface sealing during preceding dry runs. Field data were obtained in Minnesota on four soil types (loam, loamy sand, and two clay loams) using a sprinkling infiltometer. These infiltration models should be used with caution on disturbed watersheds and on soil susceptible to surface sealing. (Cassar-FRC)
W82-05965

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-05969

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,
Arkansas Univ., Fayetteville. Water Resources Research Center.
J. T. Gilmour, J. A. Ferguson, and B. R. Wells.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254962, Price codes: A04 in paper copy, A01 in microfiche. Publication No 82, December 1981. 57 p, 16 Fig, 5 Tab, 4 Ref, 1 Append. OWRT A-045-ARK(1), 14-34-0001-8004.

Descriptors: *Computer models, *Salt balance, *hydrologic budget, *Rice, *Soybean, *Irrigation practices, Model studies, Mathematical models, Mathematical studies, Computer programs, Irrigation water, Irrigation, Physiographic balance, Physiographic provinces, Soil water, Silt, Loam, Soil types.

A computer model was developed for describing salt and water balances for a silt loam soil common to the Arkansas Grand Praire physiographic region. This model was used to assess ten years (1966-75) of weather data for two divergent cases with respect to salt accumulation: one, a rice-soybean rotation, with soybean irrigated; the other, a rice-soybean-soybean rotation, with soybean not irrigated. The salts considered were: calcium, magnesium, sodium, sulfate, chloride, and the precipitate, calcium carbonate. Without soybean irrigation, less evapotranspiration, greater infiltration, and less runoff were observed during the fallow season than when soybeans were irrigated. Other water balance differences were small. Further, annual salt additions were notably larger when soybeans were irrigated and rice occurred more frequently in the rotation. Most salt additions occurred during the rice season for either case stud-

ied. Accumulation of a given soil salt increased linearly with an increase in irrigation water concentration for that salt, with the rate of increase greatest for sulfate and least for magnesium. The weather data file and the computer program for the model are delineated. (Zielinski-MAXIMA)
W82-06172

SIZE AND SHAPE IN RAISED MIRE ECOSYSTEMS: A GEOPHYSICAL MODEL,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
H. A. P. Ingram.
Nature (London), Vol 297, No 5864, P 300-303, May, 27, 1982. 5 Fig, 1 Tab, 36 Ref.

Descriptors: *Bogs, *Model studies, Waterlogging, Drainage, Wetlands, *Peat bogs, Mathematical studies, Geophysics.

The development of raised mires or raised bogs is marked by the accumulation of peat deposits which, in surface profile, resemble inverted clock glasses. The growth of such a deposit is possible because it remains perennially waterlogged almost to its upper surface. The central parts of the surface may lie at altitudes up to 10 meters above the marginal lagg steams into which the deposit of raised mires is examined. Having identified impeded drainage as the mechanism, implications for the shapes of these ecosystems are then considered. A groundwater mound hypothesis is presented, which appears to have a secure physical foundation and is considered with evidence from various sources. The model used involves impeded drainage and is in good accordance with the structure of the peat and basic tenets of soil physics. At Dun Moss, a small raised mire in east Perthshire, enough hydrological and soil physical data were available to conduct a preliminary test, and the elliptical shape and proportions of the mire surface profile are in agreement with the model used. (Baker-FRC)
W82-06215

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 623-639, May, 1982. 9 Fig, 1 Tab, 30 Ref. OWRT A-076-ARIZ.

Descriptors: *Mathematical studies, *Boreholes, *Permeability coefficient, *Soil water, *Vadose water, Infilitration, Groundwater movement, Hydraulic permeability, Permeability, Mathematical equations, Soil water table, Water table fluctuations, Capillary water.

The accuracy of existing formulas for evaluating the saturated hydraulic conductivity or permeability coefficient in constant head infiltration tests is examined in the first part of a three part study on borehole technology. Formulas are available for open and partly cased boreholes and deep and shallow water table conditions. Not all the available solutions are compatible with each other, and some may lead to values of saturated hydraulic conductivity which differ by as much as several hundred percent from values obtained by other formulas under the same test conditions. None of the solutions account for capillary effects, soil heterogeneity, anisotropy or the possibility that part of the flow may take place under unsaturated conditions. Problems of application of Cecen's methodology to actual field situations are discussed. The United States Bureau of Reclamation formulas may also be inaccurate for an open-hole test above an impermeable layer since, in reality, the flow is not purely horizontal and takes place under nonsteady-state conditions. (Geiger-FRC)
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics, Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 640-659, May, 1982. 16 Fig, 1 Tab, 29 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Soil water, *Infiltration, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Groundwater movement, Water table fluctuations, Mathematical models, Saturation.

The mathematical accuracy of formulas used to determine the saturated conductivity from constant head borehole infiltration tests above the water table was tested under the assumption that the concept of free surface flow is valid. The effects that unsaturated soil conditions may have on the validity of the free surface concept were also studied using free surface and saturated-unsaturated flow models. Free surface model steady state simulations agreed well with analytical solutions but gave a distorted view of the infiltration process. Saturated-unsaturated models used to describe quasi-steady state conditions showed that only a small volume of soil near the borehole is completely saturated with water. An empirical solution was developed for deep table conditions to calculate the saturated hydraulic conductivity with improved accuracy. The development of a completely general formula is extremely difficult due to the effects of borehole geometry, unsaturated soil characteristics, water table depth, heterogeneity, and anisotropy. (Geiger-FRC)
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 660-677, May, 1982. 14 Fig, 2 Tab, 15 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Infiltration, *Soil water, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Water table fluctuations, Mathematical models, Graphical methods, Saturation, Soil properties, Groundwater movement, Flow rates, Permeability.

During constant head borehole infiltration tests in the vadose zone, saturated-unsaturated flow models were used to simulate transient conditions. The time required to reach steady state, the volume of injected water required to reach steady state, and the question of whether early time data from a borehole infiltration test could be used to estimate saturated hydraulic conductivity were also examined. Infiltration rate varied directly with saturated hydraulic conductivity and was affected by unsaturated soil properties, antecedent moisture conditions, anisotropy and borehole conditions. Saturated hydraulic conductivity may be overestimated if the U.S. Bureau of Reclamation method of determining when to terminate a test is used. By using a graphical method which utilizes extrapolation of data collected during the early portion of a test, lengthy tests and the need for large volumes of water are eliminated when estimating flow rate at steady state. (Geiger-FRC)
W82-06303

SIMULATION OF SOLUTE TRANSPORT USING A TRANSFER FUNCTION MODEL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury.
Water Resources Research, Vol 18, No 2, p 363-368, April, 1982. 4 Fig, 20 Ref.

Descriptors: *Simulation analysis, *Mathematical studies, *Soil water, Water transport, *Mathematical models, Flow, Soil solution, *Solutes, Spatial distribution, Probability distribution, Infiltration, Prediction, Velocity, Soil environment.

A transfer function model is proposed for simulating solute transport under natural field conditions where substantial variability exists in water transport properties. A transfer function model is a device commonly used by electrical engineers and hydrologists to characterize systems whose internal mechanisms are unknown or unknowable. This approach measures the distribution of solute travel times from the soil surface to a reference depth. Using the distribution function, it is possible to simulate average solute concentration for a given depth or time, and to predict the probability of extremely long or short travel times for a mobile chemical. Since in the few existing studies of soil water distributions, it was found that a lognormal function describes the relevant parmeter, that is the distribution to which the travel time density function is fitted in this study. (Titus-FRC)
W82-06318

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W82-06321

ESTIMATING SOIL WATER RETENTION FROM SOIL PROPERTIES,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and D. L. Brakensiek.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 166-171, June, 1982. 1 Tab, 18 Ref.

Descriptors: *Soil moisture retention, *Soil properties, Soil types, Soil water, *Matric potential.

Three levels of regression equations for predicting soil water retention at 12 matric potentials (-0.04 to -15 bar) were developed based on: (1) percent sand silt, and clay, percent organic mater, and bulk density; (2) number 1 variables plus -15 bar soil water retention value; and (3) number 2 variables plus -0.33 bar soil water retention value. Data for this study included 500 soils consisting of 2543 soil horizons from 18 states and covered a wide variety of soil types. Addition of the -0.44 bar and -15 bar soil retention values greatly increased the accuracy of the equations. These equations can be used to estimate water retention characteristics without expensive laboratory determinations. (Cassar-FRC)
W82-06332

A FIELD TEST OF THE TRANSFER FUNCTION MODEL FOR PREDICTING SOLUTE TRANSPORT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, and P. Shouse.
Water Resources Research, Vol 18, No 2, p 369-375, April, 1982. 1 Tab, 8 Fig, 13 Ref.

Descriptors: *Mathematical models, *Solutes, Field investigation, *Probability distribution, Water transport, Chloride, Irrigation, Soil water, Soil solution, Saturation, Statistical analysis, Leaching, Calibrations.

A model proposed for predicting average values of solute concentration as a function of depth and time, based on a transfer function model, is tested on a field experiment. The model, which requires knowledge of the distribution of solute travel times to a given depth within a field, predicts average soil solute concentrations and the probability of extreme behavior. The experiment consisted of an initial calibration of a pulse of solute past numerous samplers at a constant depth. The shape of the solute pulse was then predicted for different depths, with good agreement between predicted and measured values. A further test of the model involved taking soil cores after 170 days. Good agreement was found in this test as well. The experiment suggests that the number of replicate samples required depends on the degree to which extreme values are important. (Titus-FRC)
W82-06339

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT EQUATION,
Science and Education Administration, Riverside, CA. Salinity Lab.
M. T. van Genuchten, and W. J. Alves.
Technical Bulletin No 1661, June 1982. 151 p, 5 Fig, 1 Tab, 45 Ref, 2 Append.

Descriptors: *Solute transport, *Mathematical models, *Computer models, *Soil water, Convection, Adsorption, Laplace equation.

The rate at which a chemical constituent moves through soil is determined by several transport mechanisms. This compendium lists available mathematical models and associated computer programs for solution of the one-dimensional convective-dispersive solute transport equation. The governing transport equations include terms accounting for convection, diffusion and dispersion and linear equilibrium adsorption. In some cases, the effects of zero-order production and first-order decay have also been taken into account. Some of the listed solutions have been published previously. Others were not available and have been derived to make the list of solutions more complete. User-oriented FORTRAN IV computer programs of several analytical solutions are given in an appendix. All programs were successfully tested on an IBM 370/155 computer. Results of each program were compared with results based on a numerical solution of the governing transport equation, in order to check the programming accuracy of each solution. A list of Laplace transforms used to derive the analytical solutions is also provided. (Moore-SRC)
W82-06408

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,
Agriculture Research Service, Riverside, CA. Salinity Lab.
M. T. Van Genuchten.
Advances in Water Resources, Vol 5, No 1 p 47-55, March, 1982. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Solute transport, *Numerical analysis, *Soil water, *Finite element method, *Finite difference methods, Unsaturated flow, Saturated flow, Fate of pollutants, Model studies, Infiltration, Mathematical models, Hydrodynamics.

The accuracy and computational efficiency of four numerical methods for solving governing one-dimensional flow and mass transport equations are compared. The methods are those of finite differences (FD), linear finite elements (LFE), mass-lumped linear finite elements (MFE), and Hermitian cubic finite elements (HFE). These equations are useful for studying movement of fertilizers, pesticides, salts, and domestic and industrial wastes in the soil. The sample problem is a field infiltration experiment in which water and chlorides infiltrate into a deep, homogeneous soil profile. All four numerical schemes give accurate results, but the HFE scheme most nearly duplicates the correct solution. Computer times vary widely, depending on the number and size of elements, number of time steps, etc. The GFD and MFE schemes generate the most stable conditions in the presence of a steep moisture front (infiltration in a dry soil); the HFE scheme is better for locating the correct spatial position of the moisture front. Selection of a numerical scheme should consider its potential use. Factors affecting accuracy and computational efficiency are programming details of the iterative scheme, magnitude of the time step, the presence of adsorption and decay reactions, and the required accuracy. (Cassar-FRC)
W82-06547

AN EMPIRICAL METHOD FOR DETERMINING AVERAGE SOIL INFILTRATION RATES AND RUNOFF, POWDER RIVER STRUCTURAL BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
J. G. Rankl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201732, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-76, April 1982, 38 p, 18 Fig, 10 Ref.

Descriptors: *Soil water, *Infiltration rate, *Surface runoff, *Rainfall-runoff relationships, Rainfall intensity, Antecedent moisture, Channel storage, Water storage, Permeability, Soil types, Soil classification, *Wyoming, Powder River basin, Incipient ponding.

This report describes a method to estimate infiltration rates of soils for use in estimating runoff from small basins. Average rainfall intensity is plotted against storm duration on log-log paper. All rainfall events are designated as having either runoff or nonrunoff. A power-decay-type curve is visually fitted to separate the two types of rainfall events. This separation curve is an incipient-ponding curve and its equation describes infiltration parameters for a soil. For basins with more than one soil complex, only the incipient-ponding curve for the soil complex with the lowest infiltration rate can be defined using the separation technique. Incipient-ponding curves for soils with infiltration rates greater than the lowest curve are defined by ranking the soils according to their relative permeabilities and optimizing the curve position. A comparison of results for six basins produced computed total runoff for all events used ranging from 16.6 percent less to 2.3 percent more than measured total runoff. (USGS)
W82-06692

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
For primary bibliographic entry see Field 3F.
W82-06852

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,
Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
D. Russo, and E. Bresler.
Water Resources Research, Vol 18, No 3, p 438-488, June, 1982. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Unsaturated flow, *Stochastic process, Mathematical studies, Probabilistic process, Stochastic hydrology, Soil water, Infiltration, Salts.

Comparisons were made between solutions of stochastic-conceptual flow problems obtained by using two approaches: assuming that the spatial variability of soil hydraulic properties is expressed by a single stochastic parameter or assuming that this variability is described by five random parameters. Two cases of one-dimensional vertical flow were analyzed: piston flow of solute under steady uniform surface water recharge and transient water flow when a uniform recharge rate is applied on the surface. Under steady vertical infiltration, expressing the variability of the hydraulic conductivity function by the single stochastic variate gives essentially the same results as the case when the variability is expressed by three stochastic variates. The agreement between the simulated average solute concentration profiles obtained by the two methods improved as the recharge rate increased and a larger portion of the field was under ponding conditions. Similar results were found for the simulated potential runoff. For the case of the transient flow of water the variability in the hydraulic conductivity function as well as the variability in the soil water retentivity function is expressed by a scaling factor obtained from hydraulic conductivity data. Using this scaling factor as the only stochastic variate resulted in mean water content profiles which are in relatively good agreement with the mean profiles obtained when expressing the variability of the hydraulic conductivity function and the soil water retentivity function by five stochastic variates. It is concluded that the scaling factor, as a single stochastic variate, can be successfully used for stochastic analysis of water and solute flows under steady and transient infiltration conditions. (Baker-FRC)
W82-06856

MOISTURE AND HEAT TRANSPORT IN HYSTERETIC, INHOMOGENEOUS POROUS MEDIA: A MATRIC HEAD-BASED FORMULATION AND A NUMERICAL MODEL,
Massachusetts Inst. of Tech. Cambridge. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol 18, No 3, p 489-498, June, 1982. 8 Fig, 35 Ref.

Descriptors: *Soil porosity, *Model studies, *Porosity, Soil properties, *Porous media, Evapotranspiration, Groundwater recharge, Runoff, Precipitation, Rainfall, Model studies, Mathematical models.

The theory of Philip and de Vries and of de Vries is used as the basis for the formulation of a more general mathematical model of moisture and heat flow in porous media. Specifically, matric head rather than moisture content is used as a dependent variable. This makes it possible to incorporate moisture retention hysteresis and soil inhomogeneities into the theory. A physically realistic generalization of existing conceptual models of hysteresis is proposed in order that they may be applied to non-isothermal problems. The one-dimensional forms of the governing partial differential equations are solved numerically using the Galerkin finite element method. A computer code of the proposed solution algorithm is tested for accuracy in the solution of several problems. The limitation of the assumptions of local thermodynamic equilibrium are discusse e computational results demonstrate the reliability of the numerical model. (Baker-FRC)
W82-06857

COMPARISON OF METHODS OT ESTIMATE DEEP PERCOLATION RATES,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis, D. D. Evans, and A. W. Warrick.
Water Resources Bulletin, Vol 18, No 3, p 465-470, June, 1982, 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Percolation, Estimating, *Darcy's equation, Temperature effects, *Evapotranspiration, Irrigation, Soil moisture, *Root zone, Tracers, Tritium.

Three alternative methods of estimating deep percolation below the root zone when knowledge about the history of applied water and evapotranspiration is not available are evaluated. The methods studied included: the solutions of Darcy's equation for steady state conditions; the estimation of deep percolation rates based upon the distortion caused by the vertical flux of water and of the normal vertical temperature profile in the zone below 15 meters; and the use of tritium as a tracer of water movement. A field site for determining the deep seepage rate by all three methods was selected in a field west of Phoenix, Arizona. The water table was at a depth of 42 meters and the field had been under irrigation since 1950. Cropping history included field crops for the previous 18 years and vegetable crops before that time. At the principal study site the Darcy velocity of flow ranged from 9 cm per year determined by the temperature method to 40 cm per year determined by the tritium method. Darcy's equation to calculate seepage rates resulted in an estimation of deep seepage of 18 cm per year. An average deep percolation rate at the principal study site of 22 cm per year was determined using the average of all three methods. Results for other sites based on the temperature method indicated a lower seepage rate. If the three methods, the hydraulic approach offered the most direct measurement of seepage rate. However, it is also the most laborious and expensive. (Baker-FRC)
W82-06867

SEASONAL VARIATION OF INFILTRATION CAPACITIES OF SOILS IN WESTERN OREGON,
Coconino National Forest, Flagstaff, AZ.
M. G. Johnson, and R. L. Beschta.
Pacific Northwest Forest and Range Experiment Station Research Note PNW-373, 1981. 8 p, 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Infiltration capacity, *Forest soils, *Seasonal variation, *Soil organic matter, *Oregon, Wettability, Water repellent soils, Coniferous forests, Climates.

Infiltration measurements were made at two locations in Oregon: the Coyote Creek watersheds, located in the South Umpqua Experimental Forest; and the Hi-15 watersheds, located in the H. J. Andrews Experimental Forest. Both areas have relatively dry, warm summers and wet, mild winters. Douglas-Fir dominates the overstory vegetation of undisturbed sites at both areas. Infiltration capacities for the Coyote Creek and Hi-15 watersheds averaged about 50% higher in the fall than during the summer. All data on infiltration capacity appear to be normally distributed. The pattern of greater infiltration in fall, compared with summer, was found in both disturbed and undisturbed soils at both study areas. The cause of this seasonal increase in infiltration capacity is not known. Field observations indicate that during the summer months the soil surface presents a nonwettable condition. This condition may result from changes in characteristics of the soil organic matter caused by the hot and dry climate of summer. This surface-limiting condition apparently changes after the first fall rains. In contrast to the results of this study, most other investigators have found fall infiltration capacities 30-80% lower than those occurring during summer. (Moore-SRC)
W82-06961

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W82-06969

2H. Lakes

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-05912

GRAPHIC RETRIEVAL, ANALYSIS AND SPATIAL PORTRAYAL: AN INFORMATION SYSTEM FOR IDAHO'S FRESHWATER LAKES,
Idaho Univ., Moscow. Dept. of Geography.
N. B. Hultquist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243387, Price codes: A05 in paper copy, A01 in microfiche. Report, January 1982, 82 p, 7 Fig, 1 Append. OWRT A-073-IDA(1).

Descriptors: *Mapping, *Lakes, *Data storage and retrieval, *Data processing, *Computer programs, Topographic mapping, Lake classification, Data collections, Data interpretations, Computer models, Model studies, Model testing, Mathematical models, Mathematical studies, Mathematical analysis.

Activities on a data processing project related to the Clean Lakes study, designated as GRASP (Graphic Retrieval and Spacial Portrayal), are described. The rationale, description, and application of GRASP are delineated. The objective of GRASP is to develop a computer based storage and retrieval system having analysis capacilities to facilitate graphic and or spatial portrayal of raw data or of derived information needed by Clean Lakes researchers. An exhaustive search was made by the researchers to identify all Idaho lakes. The final form of this search includes lakes, reservoirs, and ponds. Each water body is uniquely identified by name, location, elevation, and size. A total of 123 high priority lakes are tagged in the system and given a water quality status (trophic status index). The information within the GRASP system can be displayed, corrected, or expanded using the editing function of the Conversational Monitoring System. Sorting, logical operations, and analyses are possible, using interactive statistical analysis system routines. Simple maps (and other graphics) are optional products available to the researchers, and lakes of interest can be spatially portrayed at the appropriate level within Idaho State/county outlines. (Zielinski-Maxima)
W82-05914

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,
World Health Organization Schistosomiasis Control Project, Accra (Ghana).
For primary bibliographic entry see Field 5C.
W82-05988

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5B.
W82-05991

FACTORS INFLUENCING ORTHOPHOSPATE TURNOVER TIMES: A COMPARISION OF CANADIAN AND NEW ZEALAND LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
E. White, G. Payne, S. Pickmere, and F. R. Pick,.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 469-474, March 1982. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Phosphates, *Turnover time, *Nutrients, Lakes, *Canada, *New Zealand, Limiting nutrients, Phosphorus, Nitrogen, Phytoplankton, Particulat matter, Seston, *Orthophosphates.

Water samples from 21 New Zealand and 9 Canadian lakes were analyzed for dissolved phosphate, particulate phosphorus, and particulate nitrogen. The particulate N was used to indicate phytoplankton biomass; the ratio of particulate N to particulate P was used to indicate P sufficiency or deficiency. Phosphate turnover times were positively related to the size of the dissolved phosphate pool, negatively related to biomass. Where P deficiency existed, phosphate turnover times were short. Particulate N/particulate P ratios for Canadian and New Zeland lake water averaged 26.96 and 12.71, respectively. In the 3 New Zeland lake groups the average particulate N/P ratios ranged from 8.61 to 16.06. The lower ratios were found in New Zealand lakes located in P-rich regions of volcanic ash and fed by P-rich springs. (Cassar-FRC)
W82-05992

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,
Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-05993

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,
New York State Department of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5C.
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,
Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-05996

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06034

ANALYSIS OF LAKE VICTORIA LEVELS,
G. W. Kite.
Hydrological Sciences Bulletin, Vol 27, No 2, p 99-110, June, 1982. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Lakes, *Water level, *Lake Victora, Model studies, Mathematical studies, Hydrologic models, Mathematical models, Water level fluctuations.

An analysis was made of time series of levels of Lake Victoria as measured at four points for trends, periodicities and autoregressive components. Comparisons were made with results of time series analysis of Lake Superior, which is similarly sized lake. Checks were made for evidence of differential crustal movement using differences between time series on opposiste sides of the lake. The time series of beginning of month lake levels for the period 1900-1978 contains trends, contains periodicities and contains a strong autoregressive component. The trend component of the time series is generally associaaed with changes in the structure of the series caused by natural or manmade phenomena. The presence of periodic functions is generally attributed to various astromnomical events such as the phases of the moon and the rotation of the earth. All of the Lake Victoria time series show a similar distribution of variance and are in marked conrast to the distribuion of variance for the lake level time series from Marquette on LakeSuperior. The Lake Victoria series contain large (greater than 50%) linear trends, while the Marquette series contains a large periodic component. All series contain a large autoregressive component. The linear trand components in the Lake Victoria series are largely caused by the step inlake levels in the early 1960's. Since it appears that this rise in lake level is not manmade, the time series cannot be legitimately homogenized by removing the steps, and any method of analysis which is to be of use in modeling must incorporate a random jump component. (Baker-FRC)
W82-06201

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,
Rhode Island Univ., Kingston. Dept. of Chemistry.
For primary bibliographic entry see Field 2D.
W82-06216

HEAVY METALS IN ANIMALS OF LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 5C.
W82-06284

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5B.
W82-06285

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,
Arhus Amtsvandvaesen (Denmark).
For primary bibliographic entry see Field 5C.
W82-06313

HYPOLIMNETIC REDOX AND PHOSPHORUS CYCLING IN HYPEREUTROPHIC LAKE SEBASTICOOK, MAINE,
Maine Univ. at Orono. Dept. of Geological Sciences.
L. M. Mayer, F. P. Liotta, and S. A. Norton.
Water Research, Vol 16, No 7, p 1189-1196, July, 1982. 10 fig, 2 Tab, 42 Ref. OWRT A-039-ME.

Descriptors: *Nutrients, *Lakes, Eutrophication, *Cycling nutrients, *Phosphorus, Alkalinity, Oxygen demand, Hypolimnion, Thermal stratification, Ammonium, Methane, Iron, Manganese, Sulfides, Sediments, *Maine, Lake Sebasticook.

The types of reduced species delivered to the metalimnion of a hypereutrophic lake are examined. The dynamics of hypolimnetic water chemistry were considered through the summer stratification period with emphasis on the factors controlling the introduction of reduced species to the water column, internal cycling of these species and their effect on phosphate delivery to the epilimnion. Lake Sebasticook is a hypereutrophic lake used for the investigation. The establishment of winter and summer anoxic hypolimnia in Lake Sebasticook followed a pattern typical of a eutrophic dimictic lake. Summer fluctuations of the oxycline represented intrusions of hypoxia into the metalimnion and lower epilimnion rather than massive reoxygenation of the hypolimnion. The response of iron and manganese to this anoxic period was release of both metals from the sediments immediately after the onset of hypolimnetic anoxia, increased in concentration in the hypolimnion throughout the summer, manganese developing an upper hypolimnetic maximum in the late summer-early fall and iron retaining a lower hypolimnetic maximum indicative of release from the sediments. Total phosphorus showed a pattern similar to the metals, building up intensively in the hypolimnion and to a much lesser extent in the epilimnion. Potassium was also apparently released from the sediments during the summer, perhaps resulting from an ion exchange reaction in which potassium was displaced by ammonium derived from deamination of organic material. Considerable alkalinity was also released from the sediments. (Baker-FRC)
W82-06337

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7C.
W82-06370

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 5C.
W82-06383

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,
Australian Water Resources Council, Canberra.
For primary bibliographic entry see Field 5G.
W82-06385

STUDIES OF THE EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, and J. J. Sartoris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237074, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-82-7, December 1981. 59 p, 41 Fig, 9 Tab, 48 Ref.

Descriptors: *Limnology, *Plankton, *Nutrients, *Productivity, *Twin Lakes, *Pumped storage, Reservoirs, Chlorophyll, Phosphorus, Nitrates, Benthos, Water temperature, Conductivity, Dissolved oxygen, *Colorado, Twin Lakes.

This report presents the results of studies done in 1980 as part of the preoperational investigations of the limnology of Twin Lakes. Maximum water temperatures were recorded in August 1980 and were about 17 and 18 C for the upper and lower lakes, respectively. The lowest measured dissolved oxygen concentration was 1.3 mg/l at the bottom of the lower lake in October. The pH ranged between 6.3 and 8.3, and the conductivity levels were between 64 and 90 micro S/cm. Total phosphorus concentrations never exceeded 2 micro g/l during 1980, while nitrate nitrogen ranged from less than 10 to 90 micro g/l. Average daily primary productivity rates ranged from a low of 1.6 mg C/ (sq m/d) in the upper lake during January to a high of 143.5 in the lower lake during November. Chlorophyll a concentrations ranged from 0.6 mg/cu m below 14 m in the lower lake during April to 18.0 mg/cu m near the bottom of the epilimnion in the upper lake during September. Average phytoplankton and zooplankton densities reached maximum of just over 13,000 and 125.8/L, respectively, during August in the lower lake. Phytoplankton populations were dominated by diatoms and dinoflagellates, while zooplankton populations were dominated by copepods, oppossum shrimp, and rotifers. The benthos of Twin Lakes is dominated by chironomids, oligochaetes, and fingernail clams reaching maximum densities respectively of 2922, 800, and 974/sq m in the lower lake, and 1969, 2813, and 173/sq m in the upper lake. (Moore-SRC)
W82-06403

HYDROTHERMAL ANALYSIS OF LAKES AND RESERVOIRS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. R. F. Harleman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 301-325, March, 1982. 16 Fig, 40 Ref.

Descriptors: *Hydrothermal studies, *Mathematical studies, Fluid mechanics, Lakes, Reservoirs, Physical properties, Thermal properties, Prediction.

This paper, of 'First Hunter Rouse Hydraulic Engineering Lecture', reviews the impact of Hunter Rouse's work on the application of fluid mechanics to hydraulic engineering practice in the United States. The development of physical and mathematical techniques for the prediction of the hydrothermal structure of lakes and reservoirs provides an example of the application of concepts put forth by Rouse. One-dimensional models for the vertical temperature structure of lakes and reservoirs may be either diffusion models or mixed-layer models. The development and testing of early mathematical models based on the vertical diffusion concept depended heavily on the use of laboratory models. These models are very sensitive to variations in turbulent diffusivity, internal heat absorption, and vertical advection due to inflows and outflows. A wind-mixing model is proposed as an alternative to specification of temporal and spatial variations in the vertical diffusivity. A wind-mixing algorithm converts turbulent kinetic energy input by wind shear to potential energy through entrainment of hypolimnetic water across the thermocline. A heat balance based on meteorological inputs averaged over hourly or daily time steps is achieved through the use of an interactive technique. This ability to predict the thermal structure of lakes and reservoirs a short time intervals permits the inclusion of this factor in water quality models. Temperature predictions of the numerical model are compared with field data for several lakes and reservoirs. (Carroll-FRC)
W82-06425

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W82-06470

ZOOPLANKTON AND THEIR RELATIONSHIPS WITH WATER QUALITY AND FISHERIES,
Leicester Univ. (England). Dept. of Adult Education.
D. M. Harper, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 135-145, March, 1982. 10 Fig, 23 Ref.

Descriptors: *Zooplankton, *Plankton, *Reservoirs, Water supply, *Water quality data, Fish, *Reservoir operation, Succession, Water treatment, Water sampling, Water quality, Seasonal variation, Rutland Water, England.

Zooplankton population structure in Rutland Water changed over the first five years of the reservoir's existence. Daphnia pulex, initially dominant, was replaced by D. hyalina in late 1975, and since 1979 the latter has coexisted with Bosmina longirostris. Population fluctations of all the main crustacean zooplankters were erratic in the first three years, but have since become more regular. The pattern of zooplankton population change is now similar to that of other lowland reservoirs. The seasonal changes in the populations of the main grazers are becoming predictable, but the effect of grazing upon the algae and their succession during the summer is not yet clear. It is anticipated that a clearer understanding of grazing pressure will be of value to the future management of the reservoir. (Titus-FRC)
W82-06472

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,
Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
A. J. D. Ferguson, and D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 117-133, March, 1982. 2 Tab, 11 Fig, 34 Ref.

Descriptors: *Phytoplankton, *Pumping, *Succession, *Reservoirs, Water supply, England, Catchment areas, Water quality control, Water quality, Prediction, Lakes, Algal blooms, Filtration, Water quality data, Rutland Water.

The development of a seasonal succession of phytoplankton species in Rutland Water is described, and the factors controlling their succession and abundance are discussed. At present, input of water from the catchment and by pumping from the rivers flowing into the reservoir has the greatest influence on phytoplankton abundance. Temperature, fluorescence and oxygen percentage saturation were continuously monitored, as were meteorological factors. Chemical and algal sampling was carried out at weekly intervals at each of thirteen sites. Results of the monitoring showed that increasing stabilization of phytoplankton successional dominance occurred. Currently, the predictive capabilities that result from the study rely on observed changes in growth patterns and experience gained from past data on species succession. The factor considered most readily manipulable in the control of algal populations is the degree of stratification. Examination of the relationships between the mixed depth algal concentrations and species succession have not produced any predictable relations to date. (Titus-FRC)
W82-06473

VERTICAL MOVEMENTS OF THE SURFACE WATER AND THERMAL STRATIFICATION IN RUTLAND WATER,
University Coll. of Swansea (Wales). Dept. of Oceanography.
S. L. Maddocks.

Hydrobiologia, Vol 88, No 1-2, p 79-87, March, 1982. 5 Tab, 5 Fig, 6 Ref.

Descriptors: *Thermal stratification, *Stratification, *Thermocline, *Reservoirs, *Seiches, Thermal capacity, Wind-driven currents, Currents, Oscillatory waves, Dams, Upwelling, Eutrophication, Topography, Water treatment, Stress, Rutland Water, England.

Vertical movements of the water surface in Rutland Water were examined using water level gauges. The timing and extent of the surface seiches and slopes due to wind stress were not well correlated with wind speed and direction: this is thought to be due to the complex shape of the reservoir. Where the lake consists of many bays and dendritic parts, the oxygen concentration is very different, and each unit often operates as essentially an individual lake. Therefore, the structure of oxygen distribution becomes highly variable horizontally, vertically, and temporally. Unexplainable diel oscillations of the water surface were observed, and an examination of the thermal stratification showed the presence of upwelling and downwelling. The ability to predict seiching is important to engineers for upkeep and dam construction, since seiching (oscillations) helps keep inlets in the reservoir clear of sediment buildup, while producing extra stress on the dam. (Titus-FRC)
W82-06476

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESUSPENSION IN THE EASTERN BASIN OF LAKE ERIE,
Eidenossische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewasserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 2J.
W82-06494

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06496

METHANOGENESIS IN BIG SODA LAKE, NEVADA: AN ALKALINE, MODERATELY HYPERSALINE DESERT LAKE,
Geological Survey, Menlo Park, CA.
R. S. Oremland, L. Marsh, and D. J. DesMarais.
Applied and Environmental Microbiology, Vol 43, No 2, p 462-468, February, 1968. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Methanogenesis, *Methane, *Saline lakes, Methanol, Lake sediments, Biochemistry, Chemical reactions, Salinity, Microbiological studies, Methane bacteria, Lakes, Big Soda Lake, *Nevada.

Although methanogenesis has been studied in a wide variety of aquatic environments, there have been few reports on methanogenesis in hypersaline environments in spite of the apparent phylogenetic link between methanogens and extreme halophiles. This paper reports on methanogenic activity in the sediments of Big Soda Lake, a moderately hypersaline, alkaline desert lake in Nevada. Incubated sediment slurries from the lake produced significant levels of methane. Methane production by the sediment slurries had a pH optimum of 9.7 and was stimulated by methanol, trimethylamine, and methionine. Methanogenesis was inhibited by 2-bromoethanesulfonic acid and by autoclaving. Hydrogen, acetate, and formate amendments were found to provide only slight or no stimulation of methanogenesis in these slurries. A methanol-grown enrichment culture containing a small epifluorescent coccus as the predominant organism was recovered from sediments. This enrichment grew best when ferric sulfide (FeS) or autoclaved sediment particles were included in the media, had a pH optimum of 9.7, and produced 14CH4 from 14CH30H. The methane formed by methanol-grown enrichment cultures was depleted in 13C by 72% to 77% relative to the methanol. (Carroll-FRC)
W82-06535

TERMINOLOGICAL CONFUSION--LAKE VS. RESERVOIR,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 203-205, 1982.

Descriptors: *Lakes, *Reservoirs, *Lake classification, *Nomenclature, Definitions, Arid Climates, Water level fluctuations, Climates, Silting, Sedimentation, Reservoir releases.

The difference between the terms 'lake' and 'reservoir', which are often used interchangeably, is clarified. Lakes are natural water bodies, and reservoirs are manmade. Lakes are formed from natural processes such as faulting, volcanism, glaciation, and others, whereas reservoirs are formed by interfering with natural processes. Lakes are abundant in humid regions, but reservoirs may be built anywhere, even in arid or semi arid places as long as imported water is available. Lakes occupy closed depressions; reservoirs are open at one end and man-enclosed at the other. Most lakes are older than modern civilization, but reservoirs are relatively recent. Lakes have a longer life span than reservoirs, which are readily filled with sediments. Lakes are in harmony with the natural environment; reservoirs alter the biological communities, sometimes favorably and sometimes unfavorably. In lakes water exchange, circulation, and water levels are rather uniform. Reservoirs often have rapid releases and water level fluctuations up to 70 m (Shasta Reservoir). Lakes become more eutrophic with time while reservoirs are flushed more frequently, delaying eutrophication. Although lakes were very important economically in ancient times, the economic impact of reservoirs is now much greater. (Cassar-FRC)
W82-06551

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06570

CALCULATION OF CURRENTS IN LAKE ONEGA WITH CONSIDERATION OF ANTHROPOGENIC INFLUENCES,
Z. N. Dobrovol'skaya, P. P. Koryavof, and A. I. Simonov.
Water Resources, Vol 8, No 3, p 278-281, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 100-104, May/June, 1981.

Descriptors: *Water currents, *Wind-driven currents, *Diversion, Lakes, Water circulation, Lake Onega, Water transfer, Model studies, Numerical analysis, Mathematical models, River flows, Svri' River, Vytegra River, Runoff, Hydraulics, *USSR, Hydrodynamics.

The dynamics of currents in lakes were described by a two-dimensional hydrodynamic model in which the wind effect, river outflow, bottom friction, and Coriolis forces were considered. The particular problem considered was that of determining the zone of Lake Onega in which changes in the current were localized as a result of water being diverted from the Svir' River to the Vytegra River. The numerical method observed that the boundary of the zone of influence of redistribution of the runoff (established on the basis of a 10% difference in current speeds) varied depending on wind direction and volume of redistributed water. The variations were localized in the southern part of the lake at a distance of less than 19 km from the southern boundary for all wind conditions investigated, except a complete calm. (Cassar-FRC)
W82-06612

NUMERICAL MODELING OF WIND-DRIVEN CURRENTS IN LAKE CHUDSKOE,
Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
G. V. Volkova, V. I. Kvon, and T. N. Filatova.
Water Resources, Vol 8, No 3, p 271-278, May/June, 1981. 3 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 3, p 91-99, May/June, 1981.

Descriptors: *Water currents, *Water circulation, Wind-driven currents, Bottom currents, Lake Chudskoe, *USSR, Model studies, Mathematical models, Lake circulation, Numerical analysis, Hydraulics, Hydrodynamics.

A mathematical model for calculating wind-driven currents in seas and inland water bodies was evaluated by comparing model results with 1971-77 field data from Lake Chudskoe, 2670 sq km in area and 7.8 m deep. Calculations of the wind-driven currents showed that currents in the surface layer coincided with wind direction and agreed within 1-3% of observed values. In the bottom layer two circulations developed in the presence of WNW winds: northern anticyclonic and southern cyclonic, the centers of which were in shallow places. Model results of the bottom layer corresponded well with field data. For WNW winds maxiumum current speeds (15-19 cm per sec) were seen in cyclonic circulation; for WSW winds (10-14 cm per sec) in the anticyclonic circulation. The model predicted slightly lower current speeds than were observed. There was also some discrepancy in the region covered by the anticyclonic circulation in case of WSW winds. (Cassar-FRC)
W82-06615

USING DIFFERENCES AMONG CARLSON'S TROPHIC STATE INDEX VALUES IN REGIONAL WATER QUALITY ASSESSMENT,
Metropolitan Council, St. Paul, MN.
R. A. Osgood.
Water Resources Bulletin, Vol 18, No 1, p 67-74, February, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Trophic level, *Water quality, Regional analysis, Data interpretation, Lakes, Lake classification, Chlorophyll, Phosphorus, Secchi disks.

The principal advantage of Carlson's trophic state index used in water quality assessments is that it presents the trophic condition on a 1 to 100 scale easily understood by both the public and the scientific community. However, the ability of the index to communicate trophic information is lessened when three values are reported: trophic state index calculated from total phosphorus, from chlorophyll a, and from Secchi disk transparency. There is at present no systematic way to account for differences among the three index values. Large differences in the three index values may result from either or both of two sources: regional relationships between chlorophyll and either Secchi depth or phosphorus may be different than those used to originally derive the index, and/or a modifying process may be altering the relationship on one of the trophic state index values with respect to the others. Two methods which can be used to account for differing trophic state index values on a regional basis are proposed. The first provides a simple procedure for transforming the trophic state index information to make it consistent with regional relationships between chlorophyll and either Secchi depth or phosphorus. The second uses the three index values to identify modifying processes in a lake and may indicate which value, or combination of values, best reflects the lake's trophic condition. Limnetic data from 60 lakes in the Twin Cities (Minnesota) metropolitan area are used to demonstrate these techniques. Only minor modifications should be needed to apply the procedures to other regional situations. (Carrol-FRC)
W82-06625

SECCHI DISC RELATIONSHIPS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, J. J. Cooper, and S. Vigg.

Water Resources Bulletin, Vol 18, No 1, p 121-123, February, 1982. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Secchi disks, *Reservoirs, *Mathematical equations, Trophic level, Lake classification, Turbidity, Water quality, Transparency, Artificial lakes, Optical properties, Eutrophication.

The problem of estimating bulk light extinction coefficients in surface water impoundments is addressed. Since artificial impoundments tend to be more turbid than natural impoundments, their optical properties, and therefore the Secchi disk depth, tend also to differ from natural impoundments. An accurate method for estimating the bulk extinction coefficient from the Secchi disk depth is demonstrated. The derived equation differs signigicantly from that derived by Poole and Atkins in 1929. The empirical expression developed for the extinction coefficient is then used to derive a semi-empirical expression for the eutrophic depth as a function of the Secchi disk depth. The relationships derived provide reasonably accurate fits of the data collected by several investigators under diverse conditions in a number of artificial impoundments. It is recommended that the results of this effort be applied only in artificial impoundments. (Carroll-FRC)
W82-06627

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. M. Jacoby, D. D. Lynch, E. B. Welch, and M. A. Perkins.
Water Research, Vol 16, No 6, p 911-919, June, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Lakes, *Phosphorus, Eutrophication, Sediments, *Lake sediments, Lake restoration, Cycling nutrients, Macrophytes, Decomposition, Decomposing organic matter, Drawdown, Long Lake, *Washington.

The respective roles of sediment and aquatic macrophytes in contributing to high phosphorus and algal content during the summer in a shallow, eutrophic lake were investigated. The 137 ha lake studied, Long Lake in western Washington, has a mean depth of 2 meters and a rather high flushing rate ranging from 3.6 to 8.0/yr. The water is soft, with alkalinity ranging from 20 to 40 mg/liter as calcium carbonate. Short-term water and phosphorus budgets were calculated for about 2 week intervals from 1976 through 1980. Results from P distribution in the lake and sediment core analyses implicate sediments as the major source of internal P loading during the summer months. Macrophyte mining of P removes AI-P (total available inorganic P) and enriches the organic P fraction in the surface sediment, thereby decreasing the AI-P pool. Anaerobic release of P was not considered significant in this lake, as stratification does not occur and oxygen depletion near the sediment has not been noted. Instead, at high pH, substantial release of P occurs from Long Lake sediment. As a component of a restoration program, the lake was drawn down nearly 2 meters for 4 months during the summer and fall of 1979, resulting in an 84% reduction in macrophyte biomass in 1980 but only minimal sediment consolidation. Winter decomposition of the much smaller macrophyte crop apparently provided insufficient phosphorus in the spring to stimulate phytoplankton and to enrich midlake sediments, which probably occurred in previous years. During the summer of 1980 internal loading of phosphorus was reduced and total phosphorus remained below 50 micrograms/liter. (Baker-FRC)
W82-06663

BATHYMETRY AND AQUATIC PLANTS OF LAKE WARAMAUG, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp.
Geological Survey Open-File Report 81-477 (WRI), 1981. 1 Sheet, 3 Ref.

Descriptors: *Maps, *Bathymetry, *Lakes, *Aquatic plants, Lake morphometry, Fathometers, Sounding, Data collections, Sampling, *Connecticut, Lake Waramaug.

The Bathymetry of Lake Waramaug is shown at 5-foot intervals, and the location and identification of significant concentrations of aquatic plants is indicated. The bathymetry shows the lake to be relatively steep-sided and flat-bottomed, with a maximum depth of between 40 and 45 feet. Aquatic plants were confined to the edges of the lake in depths of less than 15 feet. Nine species of aquatic plants occcur in significant numbers in the lake. Lake bathymetric data were collected using a recording fathometer and sounding rod; aquatic plant data were collected by visual survey; and the collection of samples using a weed rake. (USGS)
W82-06678

ONE-DIMENSIONAL RESERVOIR-LAKE TEMPERATURE AND DISSOLVED OXYGEN MODEL,
Geological Survey, NSTL Station, MS. Water Resources Div.
L. B. House.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-200 726, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-5, 1981. 114 p, 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Computer models, *Forecasting, *Dissolved oxygen, *Water temperature, Lakes, Reservoirs, Documentation, Thermal stratification, Oxygen demand, Heat transfer, Vertical distribution, Mixing, Selective withdrawal, Reservoir releases.

This report describes and documents a one-dimensional computer model that predicts dissolved-oxygen and temperature profiles in a lake or reservoir. Downstream release dissolved-oxygen concentrations and temperatures also are computed based on a user-specified outflow withdrawal elevation. The model can, therefore, be used to compare top-draw versus bottom-draw outlet configuration effects on downstream dissolved-oxygen and temperature conditions. The dissolved-oxygen and temperature profiles are computed for a conceptual vertical water column located at the deepest point in the lake or reservoir. The water column is divided into a series of uniform thickness horizontal layers for computation purposes. The model operates on a daily simulation interal, with summary output given for each day and detailed depth profiles printed on user-specified days. Model options allow the simulation of 5-day biochemical oxygen demand, sediment oxygen demand, and the density current effects of inflowing suspended sediment. The model is a modification of the U.S. Army Corps of Engineer's 'WESTEX' model number 722-F5-E1011. The user-specified withdrawal elevation, dissolved oxygen, biochemical oxygen demand, sediment oxygen demand, and suspended sediment simulation capabilities were not present in the earlier 'WESTEX' model. The model is capable of simulating a stratified reservoir pool environment. (USGS)
W82-06687

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. R. Have, G. A. Payne, and M. A. Ayers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-219235, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-40, 1981. 38 p, 12 Fig, 10 Tab, 27 Ref.

Descriptors: *Limnology, *Lakes, *Water quality, *Environmental effects, Chemical properties, Biological properties, Physical properties, Water sampling, Water analysis, Data collections, Eutrophication, Cyanophyta, *Minnesota, Apple Valley, Alimagnet Lake, Farquar Lake, Long Lake.

Alimagnet, Farquar, and Long Lakes, in Apple Valley, Minn., were sampled from 1973-79 to determine their physical and chemical characteristics. A storm-sewer inlet to Alimagnet Lake was also sampled during two storms in 1978. The 1976-77 drought caused a more noticeable effect on the quality of the lakes than any other factor. Chloride concentrations were 10 to 15 milligrams per liter before the drought, but increased 2 to 4 times during the drought. Dissolved solids reacted similarity. Dissolved oxygen and pH were governed mainly by biological activity. In February 1977, dissolved-oxygen concentration was less than 0.5 milligrams per liter in the three lakes. Ratios between mean total nitrogen and mean total phosphorus ranged from 22:1 to 26:1. Trophic-state indices indicate that the lakes are eutrophic. Bluegreen algae dominated the phytoplankton populations. Storms sampled at a storm-sewer inlet to Alimagnet Lake showed higher concentrations of chromium, copper, nickel, and zinc than of lead, arsenic, cadmium, and mercury. Total phosphorus for the September 1978 storm had a concentration of 1.7 milligrams per liter, which means that approximately 29 pounds entered the lake during the 5.5-hour sampling period. (USGS)
W82-06690

50 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (50 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
For primary bibliographic entry see Field 5G.
W82-06716

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,
Massachusetts Univ., Boston. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06720

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,
Washington Univ., Seattle. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5C.
W82-06746

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5C.
W82-06749

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,
Kumaun Univ., Nainital (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),
For primary bibliographic entry see Field 5C.
W82-06765

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,
Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W82-06779

METHANE FLUX IN THE GREAT DISMAL SWAMP,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. C. Harriss, D. I. Sebacher, and F. P. Day.
Nature (London), Vol 297, No 5868, p 673-674, June 24, 1982. 1 Fig, 33 Ref.

Descriptors: *Methane, *Swamps, Peat bogs, Bogs, Sinks, Atmosphere, Wetlands, Marshes, Cycling nutrients, *Great Dismal Swamp, *Virginia.

A study was made of plant ecology, soils and nutrient cycling in the Great Dismal Swamp, Virginia. This study provided an opportunity to examine ecological and climatological factors in relation to temporal variations in methane flux. All of the methane flux measurements reported were taken in a maple-gum habitat. Seasonal inundation of the maple-gum habitat varied in depth and frequency, reflecting local rainfall. All fluxes reported were obtained from soil or water surfaces without vegetation in open or closed sampling chambers. Measured emissions of methane from waterlogged soils to the atmosphere ranged from a low of .0013 g methan/sq m/day in December to a high of 0.0197 g methane/sq m/day in April. From September to December, the methane emission rate decreased as soil temperature decreased. During March and April, the methane emission rate increased as soil temperature increased. It is suggested that microbial activity in the soil profile is stratified, with methane oxidizing microorganisms living in the shallow aerobic surface layer and methane producing microorganisms living at depth in an oxygen depleted habitat. Methane fluxes to the atmosphere from maple-gum peat soils in the Dismal Swamp were generally lower than flux rates measured for other wetland soils. During the reversal of the flux from July 1980 to February 1981, the Great Swamp acted as a sink for atmospheric methane. Methane removal from ambient air over the soil surface is associated with drought conditions. The water table dropped below the bottom of the surface peat, producing a relatively dry, porous soil. From October 1980 to February 1981 the methane flux from the atmosphere to the soil decreased as soil temperature decreased. These findings raise questions concerning the generally accepted estimates of global methane emissions from wetlands and the assumption that soils are not a significant sink for atmospheric methane. (Baker-FRC)
W82-06840

RESERVOIR WATER QUALITY SAMPLING DESIGN,
Ford, Thornton, Norton and Associates, Ltd., Vicksburg, MS.
K. W. Thornton, R. H. Kennedy, A. D. Magoun, and G. E. Saul.
Water Resources Bulletin, Vol 18, No 3, p 471-480, June, 1982. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Reservoirs, *Water quality sampling, *Sampling, *Water sampling, Gradients, Monitoring, Lakes, Limnology, *Arkansas, DeGray Lake.

Several differences are described between reservoirs and lakes, and their influence on sampling design is discussed. A comparison of 309 natureal lakes and 107 reservoirs has indicated that the reservoirs had greater drainage and surface areas, drainage/surface area ratios, mean and maximum depths, shoreline development ratios, and areal water loads than did natural lakes. Reservoirs also had shorter hydraulic residence times and lower total phosphorus and chlorophyll concentrations, despite higher total phosphorus and nitrogen loadings. Reservoirs also exhibited pronounced longitudinal gradients, a phenomenon not unexpected considering the importance of advective and unidirectional transport in reservoirs. Intensive water quality transect samplings were conducted on DeGray Lake, a reservoir located in southern Arkansas, to describe and characterize lateral, longitudinal, and vertical water quality gradients. DeGray Lake exhibited marked longitudinal and vertical variation during all sample trips. Longitudinal variations were attributed to the existence of gradients from head water to dam. Turbidity and total phosphorus concentrations in the epilimnion, metalimnion, and hypolimnion decreased with the distance downstream during all trips. Epilimnetic chlorophyll a concentrations were lower and similar for all transects during the January sampling, but decreased in a downstream direction in July and October. The identification of the general location of gradients prior to the initiation of a montoring program would allow logical positioning of sampling stations. The sampling program design should be reviewed at least on an annual basis. (Baker-FRC)
W82-06868

PHYSICAL PROCESS AND EUTROPHICATION,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5C.
W82-06878

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,
Kinnert Limnology Lab., Tiberias (Israel).
S. Serruya, and E. Hollan.
Archiv fur Hydrobiologie, Vol 92, No 2, p 137-160, September, 1981. 14 Fig, 5 Tab, 7 Ref.

Descriptors: *Lakes, *Oscillatory waves, *Seiches, Waves, Lake Kinneret, *Israel, Management, Surface water, Coriolis force, Water level, Water level fluctuations, Water management.

Using the two-dimensional theory of Rao and Schwab, the lowest 10 normal modes of Lake Kinneret were determined. The calculations were carried out neglecting the Coriolis force, which is of minor influence on the oscillations due to the medium size of the lake. The lake itself is roughly elliptic, with a longitudinal axis of 22 km in the north-south direction and a transverse axis of 12 km length. The maximum depth of the lake is 43 meters and the mean depth is 25.6 meters. During late winter and spring, when highest water levels usually occur, the free oscillation on the lake can contribute to inundation damage, mostly during stormy periods of easterly wind which are then dominant. For a future option of lake management the normal modes have also been calculated for a water level lowered by 4 meters, 15.7% reduction of the lake's volume. The theoretical periods were verified by spectral analysis of 26 cases of observed water level fluctuations. Verification of the calculated structure was only partially achieved due to the scarcity of existing simultaneous measurements. The structures of the normal modes are discussed in detail in terms of their character, their location of nodal lines and the distribution of relative elevations. (Baker-FRC)
W82-06879

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,
Academy of Natural Sciences of Philaelphia, PA.
For primary bibliographic entry see Field 5C.
W82-06880

KINETIC ANALYSIS OF COMPETITION BETWEEN SULFATE REDUCERS AND METHANOGENS FOR HYDROGEN IN SEDIMENTS,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
D. R. Lovley, D. F. Dwyer, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1373-1379, June, 1982. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Bacteria, *Methane bacteria, *Sulfate-reducing bacteria, Sediments, *Lake sediments, Hydrogen, Eutrophic lakes, Sulfates, *Eutrophication, Wintergreen Lake, *Michigan.

The competition between sulfate-reducing and methanogenic bacteria for hydrogen was studied during summer stratification at two sites in eutrophic Wintergreen Lake, Michigan. In the upper 0-2 cm sediment layer sulfate reduction and methane production coexisted, but methane production was the dominant terminal process. Adding 10-20 nM sulfate to the naturally low-sulfate sediments produced a decrease in H partial pressure and an inhibition of methane production. Inhibition of sulfate reduction by molybdate in the sulfate-enriched sediment increased H partial pressure and methanogenesis to the rates seen in sediments unamended with sulfate. The half-saturation constants for H uptake were 141 pascal for the sulfate-reducer population and 597 pascal for the methanogen population. Thus, in the presence of sufficient sulfate, the lower half-saturation constant of the sulfate reducers allowed them to lower H partial pressures to levels unusable by methanogens. Then sulfate was not limiting, the competition between the two bacterial populations depended on the rate of H production, relative population size, and sulfate concentration. In this lake methane bacteria successfully competed with sulfate reducing bacteria because wulfate is limited. The competition for acetate is expected to have mechanisms similar to those for H competition. (Cassar-FRC)
W82-06886

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),
University Coll. of Wales, Aberystwyth. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06895

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,
Tokyo Metropolitan Univ., (Japan). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06900

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,
Maryland Univ., College Park. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06906

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,
Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06911

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,
Oklahoma State Univ., Stillwater, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,
Water Research Lab., Columbus, OH., Div. of Water.
For primary bibliographic entry see Field 5C.
W82-06932

MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,
University of Southern California, Los Angeles, Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,
State Univ. of New York Coll. at Fredonia, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,
Ontario Ministry of the Environment, Rexale, Limnology and Taxonomy Section.
For primary bibliographic entry see Field 5C.
W82-06936

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,
Michigan Technological Univ. Houghton, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,
Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,
Ecology and Environment, Incorporated, Buffalo, New York.
For primary bibliographic entry see Field 5C.
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,
Limnos Limited, Toronto, Ontario.
For primary bibliographic entry see Field 5C.
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,
Indiana Univ., Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06943

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,
Wisconsin Univ.-Milwaukee, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06976

COMPARATIVE PHOTOHETEROTROPHY, CHEMOHETEROTROPHY, AND PHOTOLITHOTROPHY IN A EUTROPHIC RESERVOIR AND AN OLIGOTROPHIC LAKE,
North Texas State Univ., Denton. Dept. of Biological Sciences.
B. K. Ellis, and J. A. Stanford.
Limnology and Oceanography, Vol 27, No 3, p 440-454, May, 1982. 6 Fig, 2 Tab, 43 Ref.

Descriptors: *Microbiological studies, Lakes, Reservoirs, *Eutrophication, *Oligotrophic lakes, Oligotrophy, Trophic level, Microorganisms, Plankton, Seasonal variation, *Lake Texoma, Algae, *Texas, *Oklahoma.

The relative contributions of various organisms to photolithotrophic, chemoheterotrophic, and photoheterotrophic activities in plankton of two sizes in two diverse lentic systems were investigated. The study site was Lake Texoma, a eutrophic impoundment of the Red and Washita Rivers in Texas and Oklahoma, and Flathead Lake, a deep, glacial lake on the Flathead River in northwestern Montana. Lake Texoma is a monomictic reservoir with a surface area of 359.6 square kilometers and a depth of 35 meters. Ultraplankton dominated plankton numbers and metabolic activity in both systems. An increase in photolithotrophy during the fall was due to an increase in the activity, numbers/ml or both of specific phytoplankters rather than an increase in the percentage of viable cells. Many of the most abundant species were not the most productive in terms of inorganic C fixation. Single species dominated total inorganic C fixation in both systems. Light mediated uptake of glucose was extensive in Flathead Lake. Light bottle uptake averaged 365% of dark bottle uptake. Autoradiographs indicated that bacteria were responsible for the observed light-mediated uptake of glucose in both lakes. Chemoheterotrophy dominated all Lake Texoma samples. Simultaneous in situ NaHCO3 and glucose incubations in Lake Texoma revealed an ability of Oscillatoria agardhii (Gomont) to be mixotrophic as well as photoheterotrophic. (Baker-FRC)
W82-06978

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,
Utah State Univ., Logan. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,
All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 5C.
W82-06982

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06991

2I. Water In Plants

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 6B.
W82-05966

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2 p 372-376, March/April, 1982. 3 Fig, 4 Tab, 23 Ref.

Descriptors: *Crop yield, *Irrigation, *Reservoir storage, Model studies, *Corn, Reservoir design, Soil-water-plant relationships, Rainfall-runoff, relationships, Hydrologic models, *Supplemental irrigation, *Kentucky, Watershed management.

A watershed runoff model and a corn yield model were combined to describe corn yields as a function of reservoir size. Components of the model were; crop growth-soil function, water supply function-runoff model, reservoir water balance-reservoir sizing routine, site characterization, and climatic simulation. A hypothetical farming operation was simulated, assuming a 100 acre corn planting and 300 acre watershed in central Kentucky. A series of probability curves (corn yield vs. reservoir storage volume) were produced. For this example, a 6000 cu m reservoir would allow yields of 8000 kg per ha or greater 96% of the time. (Cassar-FRC)
W82-05967

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
G. S. Chaturvedi, P. K. Aggarwal, and S. K. Sinha.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 738-745, October, 1981. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Water stress, Plant growth, *Barley, Irrigation, Irrigation requirements, Moisture stress, Crop yield, Moisture availability, Stress, *Wheat, *Triticale, *India.

The response of flag-leaf and other leaves to water availability was studied in several cultivars of Triticum aestivum Linn. emend. Thell., T. durum Desf., triticale and Hordeum vulgare Linn. emend. Bowden. Twenty-one cultivars were grown in the field under two moisture regimes: no irrigation versus five irrigations at different growth stages comprising crown-root initiation, jointing, booting, flowering, and grain filling. The stability of the flag-leaf size in relation to water stress was assessed. The findings indicate that in comparison with other leaves the size of the flag-leaf in different groups, and the flag-leaf size did not show the capacity to recover from the adverse effect of early stress even when water availability was adequate during the later growth period. Stress-induced reduction in flag-leaf was compensated by an increase in photosynthesis rate, as suggested by the increase in specific leaf weight. Considerable variability apparently exists in this respect within each of the groups. (Baker-FRC)
W82-05972

EFFECTS OF IRRIGATION FREQUENCY ON GERMINATION AND ON ROOT AND SHOOT YIELDS OF ACACIA SPECIES,
Shambat (Sudan). Faculty of Agriculture.
F. F. Bebawi, and S. M. Mohamed.
Plant and Soil, Vol 65, No 2, p 275-279, 1982. 2 Tab, 6 Ref.

Descriptors: *Soil-water-plant relationships, *Semiarid lands, Arid lands, Acacia species, Irrigation, Vegetation establishment, Germination.

Two experiments were performed to determine the effects of irrigation frequency on germination of Acacia seeds and growth yield of young seedlings of Acacias. In the first study there were 5 irrigation treatments replicated 4 times, including waterlogged soil, daily irrigation, irrigation at 3 days frequency, irrigation at 6 days frequency, and no irrigation (control). In the second study there were 4 treatments replicated 3 times, comprising daily irrigation (Control) and irrigation at 2,4 or 8 day frequencies. Highly different germination responses were found between species tested. Maximum germination response was realized by A. albida and minimum by A. nilotica. Over all species there were highly different responses between irrigation treatments. Daily irrigation induced the best germination response of about 57.9%, while waterlogged soil gave the second best germination response of about 10.4%. Highly significant differences were noted in root plus shoot yields between species, treatments, and species times treatment interaction. The greatest growth yield (root plus shoot) was manifested by A. nubica, while the lowest was revealed by A. nilotica, with a growth yield difference of about 59% between them. In general species of relatively dry habits were more sensitive to water supply compared with those of relatively wet habitats. This was reflected at the establishment phase by the greater production of root plus shoot yields by species of drier zones than by those of wetter ones. It is concluded that variations in water supply may account for species

adaptation and distribution in semi-arid zones. (Baker-FRC)
W82-06229

EFFECT OF WATER MANAGEMENT AND BED HEIGHT ON SUGARCANE YIELD,
Science and Education Administration, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
C. R. Camp.
Soil Science, Vol 133, No 4, p 232-238, April, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Water table, *Drainage effects, *Soil water table, *Sugarcane, Crop yield, Water management, *Louisiana, Subsurface drainage.

Sugarcane was grown in Mhoor silty clay loam in Louisiana under three water management regimes and two bed heights from 1973 to 1976. The three water management treatments were: (1) subsurface drainage with the water table at least 1.5 m below the surface, (2) water table maintained constant at 0.3 m below the surface, and (3) no subsurface drainage and variable water table responding to rainfall. The two bed heights were flat and 0.3 m high. Rainfall frequency and amount varied widely over the experimental period. Yields were adversely affected in flat beds during wet years. However, in the dry year flat bed planted sugarcane produced higher yields than raised beds. A water table depth of 0.3-1.5 m produced the best yields. During the wet years subsurface drained treatments gave significantly higher yields than the high, constant water table and variable water table (undrained) treatments. During the dry year the high, constant water table treatment produced higher yields than the low and variable water table treatments. (Cassar-FRC)
W82-06231

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 2D.
W82-06320

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson.
Water Resources Research, Vol 18, No 2, p 325-340, April, 1982. 1 Tab, 20 Fig, 34 Ref.

Descriptors: *Soil environment, *Plant-water potentials, Mathematical studies, *Canopy, *Atmosphere, *Transpiration, Runoff, Climate, Porosity, Field investigations, Water yield, *Optimization, Systems analysis, Equilibrium, Prediction.

The literature concerning ecological optimality of natural soil-vegetation systems has been reviewed and used as a guide to formulate hypotheses governing the equilibrium of water-limited systems with respect to canopy density, species water use, and hydraulic properties of the soil. A statistical-dynamic water balance is used to quantify these hypotheses. In moist climate-soil systems the soil moisture becomes insensitive to vegetation changes and can be maximized only with respect to canopy density. In humid systems the species may be subject to ecological pressure for longer-term change toward higher biomass productivity. These hypotheses result in a relationship specifying the time average evapotranspiration efficiency of landsurfaces given only the density of the vegetation canopy, a water table parameter, and a surface retention parameter. This relationship is independent of the soil properties and could produce estimates of the water and heat balances given only the properties of the climate. Combination of short-term optimal canopy density and long-term optimal biomass productivity can lead to specification of the climax vegetation canopy density and the species water use coefficient, as well as some hydraulic properties of the soil. If verified, these hypothesized relations should help in the design of land-reclamation. (Titus-FRC)
W82-06321

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 2. TESTS AND APPLICATIONS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson, and T. E. Tellers.
Water Resources Research, Vol 18, No 2, p 341-354, April, 1982. 7 Tab, 19 Fig, 28 Ref.

Descriptors: *Soil environment, *Plant water potentials, Mathematical studies, *Canopy, *Optimization, Systems analysis, Atmosphere, Climate, Runoff, Transpiration, Porosity, Field investigations, Prediction, Equilibrium, California, Massachusetts.

Tests to verify correlations between canopy density and species water use in various climates were conducted. Field observations were made at sites in Massachusetts and California. The long-term optimal climatic soil-vegetation system is defined in terms of effective porosity and plant water use, and a relationship between average evapotranspiration and optimum vegetation canopy density is derived and compared with the field observations. It was found that the predicted water balance behavior is in reasonable accord with observations. However, more research is needed, particularly for arid climates. (Titus-FRC)
W82-06322

WATER STRESS OF FOUR WINDBREAK TREE SPECIES DURING SOIL DRYING,
Northern Great Plains Research Center, Mandan, ND.
A. B. Frank.
Journal of Soil and Water Conservation, Vol 37, No 3, p 189-192, May/June, 1982. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Windbreaks, Shelterbelts, *Trees, Crops, Available water, *Soil moisture deficiency, Moisture deficiency, Green ash, Hackberry, American elm, Siberian elm, *Northern Great Plains.

Water is a major limiting factor to plant growth in the Northern Great Plains. Windbreak trees are thus susceptible to severe water stress. Stress occurs when water uptake through the roots cannot keep pace with transpiration. The rate of stress development differs among species. Water relations for green ash, hackberry, American elm, and Siberian elm trees were evaluated to determine the response to increasing soil water deficits and to relate results to field observations on competition among trees and adjacent crops and to tree growth characteristics. Leaf water potentials of green ash and hackberry, in comparison with American and Siberian elm, declined at different rates during a 2 year field study. From the initial sample data at full leaf expansion to thefinal sample data at leaves senescencing, leaf water potential dropped 30.1 bars for green ash and 27.9 bars for hackberry. These reductions compared with 10.1 and 6.2-bar reductions for American and Siberian elm, respectively. In a controlled-environment chamber, transpiration rates at high soil water potentials were considerably higher for Siberian elm than for green ash or American elm. The higher water stress in leaves of green ash and hackberry contributed to early growth cessation and leaf drop during late summer, which should reduce total soil water use by the trees and leave more water for adjacent crops. If Siberian elm were selected for early leaf drop, it would probably initiate hardening processes earlier and impart greater tolerance to winter injury and stress-related disease and insect attack. (Baker-FRC)
W82-06793

2J. Erosion and Sedimentation

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,
Wisconsin Univ.- Madison. Dept. of Geography.
For primary bibliographic entry see Field 4D.
W82-05931

DEPOSITIONAL MODEL FOR A CHENIER PLAIN, GULF OF CARPENTARIA, AUSTRALIA,
Australian Inst. of Marine Science, Townsville.
E. G. Rhodes.
Sedimentology, Vol 29, No 2, p 201-221, April, 1982, 13 Fig, 2 Tab, 67 Ref.

Descriptors: *Sedimentation, *Coastal plains, *Ridging, Tidal flats, Progradation, Chenier plains, Gulf of Carpentaria, *Australia, Runoff, Alluvial plains, Rainfall, Sediment transport.

A chenier plain (widely separated coastal ridges oriented nearly parallel to the modern coast and spread over a broad plain) in the Gulf of Carpentaria, Northern Australia, has prograded over 30 km since the Middle Holocene. This was caused by deposition of low tide muds over subtidal muds during periods of increased sediment input by rivers. The plain, extending for 150 km, consists of a series of discontinuous shell ridges resting on muddy substrates. Upland tree species grow on the ridges. Between the ridges are unvegetated mud flats or thinly vegetated clay dunes. The chenier ridges, formed during periods of reduced sediment flux by wave induced sorting and redistribution, reflected the increases and decreases in sediment flux from the rivers as a result of temporal fluctuations in rainfall over the watershed draining into the gulf. Techniques used to study the plain were core samples, geomorphic mapping, and radiocarbon dating. These findings reinforced the traditional explanations of chenier plain development. (Cassar-FRC)
W82-05957

BED-MATERIAL SIZE AND THE RIFFLE-POOL SEQUENCE,
Newcastle upon Tyne Univ. (England). Dept. of Geography.
J. A. Milne.
Sedimentology, Vol 29, No 2, p 267-278, April, 1982. 10 Fig, 4 Tab, 34 Ref.

Descriptors: *Bed sediment, *Particle size, *Riffles, Sedimentation, Streams, Sediment distribution, Sediment sorting, Gravel, Channel morphology, *Scotland, Kinglesdoors Burn.

Relationships between bed material characteristics and local riffle-pool oscillations along a channel are described. The stream examined was Kinglesdoors Burn, a small gravel bed stream in upland Scotland. The downstream sequences of bed material size were highly variable and showed no trend except for slight persistence in data over distances of 1-1.5 channel width. Riffles tended to coincide with coarser bed material sequences. Mean particle size was the most useful criterion for distinguishing between bed forms, bars being the most distinctive features. Riffles and pools were considered as downstream oscillations in elevation of a single coarser gravel sedimentary unit. Plan geometry and coarse sediment supply also influenced bed material size distributions. Tightly curved pools had the finest pool sediments and the least difference between bar and pool sediments. Larger sizes of materials in pools were negatively correlated with the index of cross section asymmetry. (Cassar-FRC)
W82-05958

QUANTITATIVE RELATIONSHIPS BETWEEN NUMBERS OF FLUVIAL CYCLES, BULK LITHOLOGICAL COMPOSITION AND NET SUBSIDENCE IN A SCOTTISH NAMURIAN BASIN,
Institute of Geological Science, London (England).
W. A. Read, and J. M. Dean.
Sedimentology, Vol 29, No 2, p 181-200, April, 1982. 9 Fig, 4 Tab, 57 Ref.

Descriptors: *Sedimentary basins, *Fluvial sediments, *Subsidence, Sedimentary rocks, Alluvial deposits, Sedimentology, Sedimentation, Sand, Stratigraphy, Geology, *Scotland, Rivers, Kincardine Basin.

Fluvial deposits in the subsiding Namurian Basin, Kincardine Basin in the Midland Valley of Scotland, were studied as a background for future computer simulation experiments and for comparison with other ancient basins. The succession of rock strata under investigation consisted almost entirely of fluvial deposits. More than 94% of the semicycles containing sand were upward-fining, leading to the conclusion that rivers were dominantly meandering. The numbers of rooting horizons and grain-size cycles and the total thicknesses of sandstone and mudstone-siltstone showed a linear relationship with the total thickness of strata and net subsidence. The average thickness of grain-size cycles showed trends toward an inverse linear relationship with net subsidence, reflecting the presence of thin stacked channel fills within persistent channel belts. These belts were localized in areas of greatest subsidence in the basin and followed courses similar to channels in the underlying delta sediments. Sand was most commonly found at points on the margin where channels entered the basin from the northwest and northeast and left to the southwest. Mudstone and siltstone were on the flanks of the basin. Coal seams were found on the flanks of the basin. The rooting horizons were most numerous in areas of low subsidence remote from main channel belts. (Cassar-FRC)
W82-05959

SPLASH EROSION MODELING: PHYSICAL ANALYSIS,
Illinois Univ., Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, J. K. Mitchell, and G. G. Bubenzer.
Transactions of the ASAE, Vol 25, No 2, p 357-361, March/April, 1982. 4 Fig, 20 Ref.

Descriptors: *Erosion, *Splash erosion, *Rain, Soil erosion, Model studies, Impact velocity, Water depth, Slopes, Interril erosion.

The splash erosion process was expressed mathematically using dimensional analysis. It is generally limited to interrill areas where erosion takes place within two different domains, drop-solid and drop-liquid-solid. The drop-solid domain was described with analytical relationships from the law of conservation of momentum. The drop-liquid-solid domain was characterized using the ratio of water depth to drop diameter. The models considered raindrop, sediment, and system parameters affecting splash erosion. Experimental data from the literature were used to evaluate the effects of various parameters affecting splash erosion. When drops were too small or their impact velocity was to low to overcome the inertia of the soil particles, no splash erosion occurred. Splash erosion increased slightly to a critical water depth of about 1 drop diameter and decreased sharply as the water depth increased beyond that point. Splash erosion was time-dependent. The horizontal displacement of sediment increased linearly as the slope angle increased, but the vertical displacement decreased nonlinearly with slope. It is possible that the effects of Froude number may be appreciable. (Cassar-FRC)
W82-05970

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,
Caulfield Inst. of Tech., Caulfield (Australia), Water Studies Centre.
For primary bibliographic entry see Field 5B.
W82-06054

CHANGES IN BOTTOM TOPOGRAPHY OF THE WESTERN SHELF ON THE NILE DELTA SINCE 1922,
National Research Center, Cairo (Egypt).
S. A. Toma, and M. S. Salama.
Marine Geology, Vol 36, No 3/4, p 325-339, July, 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Topography, *Deltas, *Nile Delta, Aswan High Dam, Dams, Bathymetry, Sediments, Rivers, Flow discharge, Sediment discharge, Erosion, Sediment distribution, Bottom sediments, Geomorphology, Continental shelf, Mediterranean Sea.

Significant changes have been noted in bottom morphology of the western continental shelf of the Nile Delta since 1922. Most of these changes were already in progress before the completion of the Aswan High Dam in 1964. The Rosetta Canyon appears to influence bottom currents and the pattern of bottom-sediment distribution. The water flow and sediment flow discharged from the Rosetta mouth toward the Rosetta canyon overcomes the current flow to the east, which prevails, or to the west, which also occurs. Thus the Rosetta Canyon serves as a sink for the eroded sediments transported offshore from Abu Quir Bay and the Rosetta fan. For sand movements on the Burullus shelf, the bottom-current velocities are of minor magnitude and only capable of transporting fine-grained material. Wave-induced currents must be the energy source for sand movements on the shelf. Stormy weather conditions are of prime importance. It is suggested that net erosion in the area off the Rosetta mouth and the retreat of the adjacent coastline probably reulted from the drastic decline of sediment on completion of the Aswan High Dam. (Baker-FRC)
W82-06094

THE ROLE OF THE AKOSOMBO DAM ON THE VOLTA RIVER IN CAUSING COASTAL EROSION IN CENTRAL AND EASTERN GHANA (WEST AFRICA),
Ghana Univ., Legon. Dept of Geology.
C. K. Ly.
Marine Geology, Vol 37, No 3/4, p 323-332, September, 1980. 9 Fig, 4 Ref.

Descriptors: *Erosion, *Dams, *Volta River, West Africa, *Ghana, Sediment discharge, Sediments, Sand, Rivers, Topography, Shore protection, Shores, Coasts, Erosion rates, *Beach erosion.

Since the building of the hydroelectric dam on the Volta River at Akosombo, West Africa, the supply of sand from the river has been greatly reduced. Whether this reduction in sand contributes to the erosion of the coast of Ghana has been investigated. About 99.5% of the river drainage basin is blocked by the dam. Comparisons were made of the average rates of shoreline retreats as determined from aerial photographs and maps during the periods before and after dam construction. The shoreline of central and eastern Ghana appears to be characterized by a general recession. This recession was not extensive on the western portion of the central coast between Cape Three Points and Winneba, where there are many protruding rock headlands. Shoreline recessions on the order of 2 to 6 meters per year are experienced on many remaining parts of the coast. The rate of shoreline recession to the west of the Volta River has remained constant before and after dam construction and thus is apparently not influenced by the dam. Since dam construction there has been a general increase in shoreline recession rates to the east of the Volta River, caused by reduction of sand supply from the river following dam construction. (Baker-FRC)
W82-06100

MINERALOGICAL INPUT OF SUSPENDED MATTER BY INDIAN RIVERS INTO THE ADJACENT AREAS OF THE INDIAN OCEAN,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian.
Marine Geology, Vol 36, No 3/4, p M29-M34, July, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Sediment transport, *Rivers, *Indian Ocean, Sediments, Minerals, Mineralogy, Oceans, Kaolinite, Illite, Quartz, Fluvial sediments, Sediment discharge, Suspended sediments, Bay of Bengal, Arabian Sea, Rivers.

Preliminary results are reported on the mineralogy of suspended sediments at the mouths of the Ganges, Brahmaputra, Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers and their relationship to the reported mineralogy of bed sediments in the Bay of Bengal and the Arabian Sea. The data suggest that kaolinite, illite, and chlorite are carried in suspended particulates of the Ganges-Brahmaputra, while the southern rivers carry high amounts of montmorillonite and small amounts of mixed-layer clays to the Bay of Bengal. The presence of montmorillonite and mixed-layer clays in the suspended sediments of the Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers would support the observations made earlier about a montmorillonite belt surrounding India. On the western coast of India, the Narmada and Tapti Rivers contribute abundant chlorite, illite, and kaolinite, and minor amounts of montmorillonite. The four southern rivers, Mahanadi, Godavari, Krishna, and Cauvery, are characterized by the absence of chlorite, abundance of montmorillonite, and presence of trace amounts of mixed-layer clays and small Jamuna, are characterized by the presence of large amounts of illite, equal quantities of kaolinite and chlorite, and little or no mixed-layer clays and montmorillonite. Central rivers such as Narmada and Tapti have mineralogical characteristics between those of the southerly and the Himalayan drainage systems. (Baker-FRC)
W82-06102

WAVES GENERATED BY RIVER AND WIND ON THE ILLINOIS AND MISSISSIPPI RIVERS,
Illinois State Water Survey, Urbana.
N. G. Bhowmik, M. Demissie, and C-Y. Guo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254897, Price codes: A05 in paper copy, A01 in microfiche.
Illinois Water Resources Center, Urbana, WRC Research Report No 167, March 1982. 90 p, 33 Fig, 11 Tab, 33 Ref. OWRT A-104-ILL(1), 14-34-0001-0115.

Descriptors: *Wind waves, *Waves, *Wave height, Rivers, *Bank erosion, *Regression analysis, Wind, Wind gages, Wind-driven currents, Translatory waves, Wave action, Wave wash, Ships, Barges, Boats, Mathematical studies, Drawdown, Illinois River, *Mississippi River.

Data on waves generated by river traffic/winds on the Illinois and Mississippi Rivers as representative U.S. waterways were collected systematically to address specific questions (the characteristics of waves from tows/barges/boats in an inland waterway; similarities/dissimilarities between these waves and those produced by natural effects; wave intensity changes as a function of increased river traffic) and the associated effect of bank erosion. The data were obtained in six field trips to four river test sites. Maximum wave heights ranged from 0.1-1.08 feet, while maximum drawdown ranged from 0.05-0169 foot. These data were compared to those expected from predictive equations, and the correlations were found to be low. However, multivariate regression analyses between measured values and hydraulic/geometric parameters which were felt to influence the generation of waves/draw downproduced two equations which predict maximum wave heights and drawdowns fairly well. In general, observed and calculated waves from river traffic and wind are both sufficient to cause stream bank erosion along the Rivers. Drawdown from loaded tows was also significant, changing flow characteristics of small tributary streams. (Zielinski-MAXIMA)
W82-06163

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center.
J. P. M. Syvitski, and R. D. Macdonald.
Canadian Journal of Earth Sciences, Vol 19, No 5, P 1025-1044, May, 1982. 19 Fig, 1 Tab, 38 Ref.

Descriptors: *Estuarine environment, Sediment analysis, *Sedimentation, Fjords, British Columbia, Howe Sound, Geology, Geomorphology, Squamish River, Fraser River, Copper, Zinc, Mine wastes, Sediment transport, *Canada.

Sediment pathways are traced from the following sources: glacially derived sediment from the Squamish River, suspended sediment from the nearby Fraser delta complex, reworked Pleistocene tills, and mine tailings from an abandoned copper-zinc mine. Howe Sound was chosen for the study as it is an estuary located close to a large urban population. Grain size data have been used to differentiate depositional versus nondepositional environments. In addition, surficial sediment samples collected from depositional basins could be modeled in terms of their size-frequency distribution and distance from source. Those that deviate from a predicted grain size distribution were found to be bimodal. Partitioning of their probability curves allowed the establishment of mixing ratios of the major sediment sources, and indicated that the Squamish-derived sediment accounted for between 80 and 100% of recent Howe Sound deposition. Semi-Quantitative X-ray diffraction analysis results can resolve the dispersion directions of each source and show that mica can be used to trace the Squamish sediment source, the chlorite pattern indicates the Fraser sediment source, and quarts is useful in delineating pathways of sediment resuspended from lag deposits. These pathways are also substantiated by gradients in copper, nickel and zinc concentrations in the sediments. Such studies are useful for areas such as this one which is too complex to model in terms of water circulation. (Baker-FRC)
W82-06189

ORIGIN OF STEP-POOL SYSTEMS IN MOUNTAIN STREAMS,
Lincoln Coll. (New Zealand). Dept of Agricultural Engineering.
J. G. Whittaker, and M. N. R. Jaeggi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 758-773, June, 1982. 5 Fig, 4 Tab, 52 Ref.

Descriptors: *Streambeds, *Stable channel, *Sediment transport, Stream stabilization, Stream erosion, Antidunes, Step-pool systems, Mountain streams, Erosion, Riffles, Deformation, Sediment sorting.

A tilting laboratory flume and a graded sediment (2-50- mm particle size) were used to study the mechanisms of step-pool formation in steep mountain streams. In highly sloped beds (.0.075), step-pool structures formed during high flow by an initial bed deforming process. The heterogeneity of the sediment caused formation of a coarse armored layer, resistant to deformation. This formed a stream bed which was very stableat low flow. At slopes <0.075, high flow formed antidunes. When the flow was reduced, the streambed had a riffle-pool appearance. (Cassar-FRC)
W82-06335

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,
San Diego State Univ., CA.
H. H. Chang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 678-689, May, 1982. 5 Fig, 15 Ref.

Descriptors: *Channel erosion, *Mathematical models, *Alluvial channels, *Aggradation, *Stream degradation, *Stream erosion, Channel flow, Erosion, Sedimentation, Stream profiles, Stream beds, Model studies.

A mathematical model was developed for predicting morphological changes in erodible channels while accounting for alterations in both channel width and bed profile of aggrading and degrading streams. The model employs methods for water and sediment routing as well as an additional condition based on the concept of minimum stream power as the width predictor. Application of the model shows that the total stream power of a reach is reduced if the widths at all cross sections are adjusted to reduce the variation in energy gradients at these sections. A varied flow will gradually develop into a uniform flow while the stream power reaches a minimum. The model has been substantiated with field data and demonstrates the validity of the concept of minimum stream power as a physical principle governing the morphology of alluvial streams. It also furnishes a basic understanding of the changes in streams in response to various environmental and hydraulic parameters. (Geiger-FRC)
W82-06336

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
R. K. Johnson, and S. A. Schumm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256587, Price codes: A06 in paper copy, A01 in microfiche. Completion Report No 10, April, 1982. 99 p, 20 Fig, 11 Tab, 29 Ref, 1 Append. OWRT B-203-COLO(1). 14-34-0001-0210.

Descriptors: *Salinity, *Saline soils, *Sediment transport, *Water pollution sources, *Dissolved soilds, *Surface runoff, Erosion, Saltation, Salt flats, Saline water, Sedimentation, Salts, Runoff, Sediment erosion, Sediment load, Water quality, Water quality control, Sediment discharge, Pollution load, Sandstones, Shales, Colorado River, Grand Valley.

Grand Valley Mancos shale, composed of a thick sequence of interbedded shale and sandstone, is a significant contributor of dissolved solids to the upper Colorado River. Research was carried out to describe the area geomorphology and soluble mineral content relationships of surficial materials in erosionally-unstable landforms, to relate geomorphic stability to salt release processes from the area, and to recommend land use and/or salt control measures for reducing salt load alluvial valley floors, and badlands, with the latter having the greatest surface area. The badlands are the least stable landform, releasing more sediment and salt into runoff than the other landforms. Pediments are capped by cemented gravels and are the most stable landform, while the alluvial valley floors are generally also stable to sediment/salt production. Recommendations for understanding erosional and salinity characteristics of runoff from the badlands and for reducing erosion/salinity related to current land use include examining the effectiveness of existing sediment retention structures, comparing sediment load and salinity of runoff from two drainage basin lithologies, and reducing gully erosion caused by road drainage ditches/culverts. (Zielinski-MAXIMA)
W82-06364

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
For primary bibliographic entry see Field 8I.
W82-06395

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,
London Coll. (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W82-06421

SEDIMENT TRANSPORT AND UNIT STREAM POWER FUNCTION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, and A. Molinas.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 774-793, June, 1982. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Sediment transport, *Energy dissipation, *Turbulent flow, Bed load, Sediment load, Sediment concentration, Sediment discharge, Fluid mechanics, Open channel flow, Channel flow, Flow characteristics, Suspended sediment, Unit stream power, Flumes, Rivers, Steady flow, Sediment discharge, Mathematical equations.

Suspended sediment concentrations at a given depth of an open channel flow are a function of the turbulence energy production rate at that depth. This hypothesis was verified by applying basic flow mechanics and turbulence theories. By integrating the rate of turbulence energy production over depth of flow, depth-averaged suspended sediment concentration was expressed as a function of unit stream power. Total sediment concentration was also described as a function of unit stream power by the process and a procedure similar to that used by Einstein. Seven total load equations were evaluated by comparing the computed results with 1093 sets of laboratory data and 166 sets of river data. Results from equations based on the concept that the rate of sediment transport in a open channel flow is related to the rate of energy dissipation of the flow produced good agreement with measured results. This group included equations proposed by Yang, Englund, Hansen, and Ackers and White. Equations by Shen and Huang and by Maddock, which lacked depth parameters, were applicable to laboratory flumes and small streams but not to large rivers. The Colby method underestimated total bed load material loads in natural rivers and was not suitable for laboratory flumes. (Cassar-FRC)
W82-06424

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,
Army Engineer District, St. Louis, MO.
G. R. Dyhouse.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 399-418, March, 1982. 15 Fig, 9 Ref.

Descriptors: *Urban watersheds, *Urbanization, *Sedimentation, *Urban runoff, Storm runoff, Land use, Prediction, Mathematical models, Dredging, Sediment discharge, Flood plains, Sediment transport, Computer programs, St. Louis, *Missouri, *Illinois.

Preconstruction planning for the Harding Ditch portion of the East St. Louis, Illinois and Vicinity Interior Flood Control Project, which is the main drainage canal for two urbanizing watersheds near St. Louis, Missouri, required an analysis of sediment deposition under current and future land use conditions and of the efects of channel modifications on the sediment regime and on the frequency and quantity of dredging required to maintain a larger channel. A grid cell data bank was used to break down each watershed by land use category and to establish the percent of the watershed in each category. Four major computer programs or methods were used to model mass runoff of water and sediment from the watersheds and deposition-erosion along Harding Ditch for existing and future (2020) land use conditions. Estimates of sediment washoff parameters for each land use category were used to compute hourly values of discharge and tons of sediment washoff per event from each watershed for 20 years of rainfall data for existing and future land use. Comparison of the current and future thalweg profiles indicated that future land use conditions will result in less sediment deposition as more and more erodable soil is covered by impervious material. If upstream erosion control measures are instituted during the construction process, any downstream depositional problems should be reduced further. Although periodic dredging will be needed to maintain the required channel geometry for any channel modification project, dredging at 10-year intervals should be sufficient to maintain a with-project rating curve relationship. (Carroll-FRC)
W82-06426

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESU-

SPENSION IN THE EASTERN BASIN OF LAKE ERIE,
Eidenossische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewasserschutz, Zurich (Switzerland).
J. Bloesch.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 748-759, May, 1982. 7 Fig, 8 Tab, 27 Ref.

Descriptors: *Sediment transport, *Lake sediments, *Lake Erie, *Sedimentation rates, *Model studies, Sediments, Sedimentation, Sediment distribution, Suspended sediments, Particulate matter, Organic carbon, Nitrogen, Phosphorus.

Sediment traps moored at three stations along an inshore-offshore transect in the Eastern Basin of Lake Erie from June to October of 1978 were used to examine differences in sedimentation processes of the near-shore and offshore environments in terms of dry weight, particulate organic carbon (POC), particulate nitrogen (PN) and particulate phosphorus (PP). Settling fluxes recorded at traps close to the lake bottom were nearly the same at all three stations during the summer stratification. At the offshore monitoring site, a comparison of the hypolimnetic traps with the epilimnetic traps showed that considerable resuspension takes place even in the summer. During the fall, however, storm-induced bottom resuspension resulted in higher nearshore sedimentation rates. A resuspension model for dry weight, POC, and PN was developed by comparing trap catches with sediment cores from all three stations. Data showed that newly formed organic material is resuspended and redeposited more frequently at nearshore locations than offshore, thus enhancing decomposition of detritus, as indicated by the low relative phytoplankton activity in the hypolimnetic traps. These cycles cause horizontal transport of fine-grained organic matter in the offshore direction and explain the significant POC and PN concentration differeces observed in the inshore and offshore sediments. (Geiger-FRC)
W82-06494

SUSPENDED SEDIMENT IN A WAVE FIELD,
Canada Center for Inland Waters, Burlington (Ontario).
M. G. Skafel, and B. G. Krishnappan.
Atmosphere-Ocean, Vol 19, No 3, p 274-278, 1981. 5 Fig, 3 Ref.

Descriptors: *Suspended sediments, *Sediment transport, *Wave action, Shear, Photography, Vortices.

A series of photographs illustrate the ripple form and the kinematics of suspended sediments in a wave field. Experiments were conducted in a wave flume in which sieved glass beads covered the bottom. Water depth was 0.15 m, wave period was 1 sec, wave height was 55 mm, mean ripple length was 37 mm, and mean ripple height was 4.6 mm. No imposed currents were present. The strong shear on the local upstream side of the ripples and the subsequent vortex developed on the downstream side were visible. Sediment was evident in the fluid above the bed to a height equal to about half the wavelength of the ripples. (Cassar-FRC)
W82-06527

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,
CH2M Hill, Bellevue, WA.
J. L. Scott.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 101-116, 1982. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Sediment transport, *Deltas, *Intertidal areas, Shores, Nisqually River, *Washington, Puget Sound, Beaches, Wave action, Sandpits, Particle size distribution, Water currents, Sediment distribution.

Sediment transport was studied along the east shoreline of the Nisqually River Delta, Puget Sound, Washington, to provide baseline data and to determine the possible effects of shoreline construction proposed by a timber company. Sediment transport on the beach was determined by interpretation by beach profiles and sediment texture and by a beach grain tagging experiment. Sediment movement on the delta platform was estimated from sediment trap data and an historical chart comparison. Several conclusions were reached from the studies. Waves are responsible for the small amount of sediment transported on the beach, and tidal currents cause sediment transport over the delta platform. The small amount of sediment transported in the intertidal zone occurs in a northerly direction, reflecting the predominance of southerly winds. The intertidal sediment consists of poorly sorted sandy gravels; the delta sediments, moderately sorted silty sands. On the delta platform sediment transport rates are 0.00004 g per cm-sec or less, with local increases due to bioperturbation. Tidal currents determine the direction of transport. The sediment grain size data indicate a depositional or no-transport environment along the eastern shore of Nisqually Reach, a U-shaped trough offshore from the delta. A man-made sandspit perpendicular to the shore, located between the proposed timber company wharf and the delta, is being gradually eroded. It has negligible effects on sediment transport in the delta platform and intertidal zones. The present wharf, north of the delta, attenuates wave energy from the north. An enlarged, improved wharf should be designed to allow nonrestricted movement of sediments and currents. (Cassar-FRC)
W82-06553

EROSION AND SEDIMENT,
Soil Conservation Service, Lanham, MD.
W. F. Mildner.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 161-166, 2 Fig, 9 Ref.

Descriptors: *Erosion, *Sedimentation, Sediment yield, Slopes, Rainfall, Vegetation effects, Sediment delivery ratio, Universal Soil Loss Equation, Suspended load, Suspended sediments, Particle size, Watersheds, Sheet erosion, Soil erosion, Reviews.

Methods of measuring erosion and sediment are described. The most commonly accepted equation for determining soil loss is the Universal Soil Loss Equation, which predicts the average annual soil loss (sheet plus rill erosion) in tons per acre. The six factors comprising the equation (rainfall, soil erodibility, slope length, slope gradient, cropping management, and erosion control practice) are discussed. Sediment yields may be determined from gross erosion and sediment delivery ratios by measuring sediment accumulation, by sampling suspended sediment loads, or by using predictive equations expressing sediment yield as a function of measurable independent variables. Sediment delivery ratios are essential to the sediment yield equation mentioned above. Factors influencing the sediment delivery ratio are types of sediment sources (channel or sheet), magnitude and proximity of sediment sources, transport system, (clogged or open channels, meandering or straight, etc.) size of eroded material (small particles are more easily transported), areas of deposition (foot of slopes, in valley flats, at the heads of lakes, etc), and watershed characteristics (high relief produces high sediment delivery ratios). One procedure for estimating sediment delivery ratio requires statistical analysis of available data where the sediment delivery ratio is a dependent variable and measureable watershed factors are the independent variables. Previous workers have also related the sediment delivery ratio to the size of drainage area, relief-length ratio, and sources of deposition. (Cassar-FRC)
W82-06554

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
A. M. Anikeenko, O. N. Litvin, and I. A. Sherenkov.
Water Resources, Vol 8, No 3, p 263-266, May/June, 1981. 2 Fig, 6 Ref. Translated from Vodnye Resursy, No 3, p 80-84, May/June, 1981.

Descriptors: *Finite element method, *Turbulent flow, *Sediment transport, Suspended solids, Suspended sediment, Settling basins, Eddy diffusion, Settling velocity, Numerical analysis, Model studies, Hydrodynamics, Mathematical models.

Transport of suspended matter in turbulent flows is examined for the separate class of problems in which small-sized, small volume concentration particles predominate (examples: suspended sediment transport, settling basins, recycled water ponds). In these cases suspended matter transport may be described by a boundary value problem for the turbulent difference diffusion equation. Where the widths of flow are small compared to the lengths (canals, horizontal settling basins, long water bodies) two-dimensional solutions can be used. Several problems are solved by the finite element method using the Ritz procedure and the concept of local potential. (Cassar-FRC)
W82-06620

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,
Oklahoma Univ., Norman. Dept. of Zoology.
B. L. Kimmel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256843, Price codes: A06 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute Report, April 1981, Stillwater. 95 p, 27 Fig, 6 Tab, 107 Ref. OWRT A-088-OKLA(2), 14-34-0001-0138.

Descriptors: *Surface runoff, *Euphotic zone, *Influent seepage, *Photosynthetic bacteria, *Suspended solids, *Reservoir stages, Watershed management, Reservoirs, Phytoplankton, Photosynthesis, Nutrient requirements, Suspended load, Field tests, Bacteria, Organic matter, Aquatic plants, Essential nutrients, Suspended sediments, Runoff.

Laboratory studies with experimental water columns and field studies in a lake were undertaken to examine the effects of introduced nutrients and suspended soil particles (SSP) on organic matter production in man-made impoundments. Watershed runoff experiments and in place monitoring of inflow events in the lake showed that turbidity associated with river-borne (SSP reduced the euphotic layer thickness, inducing light-limited phytoplankton (PP) photosynthesis in a larger portion of the water column. Nutrient desorption from SSP enhanced nutrient availability for PP and bacterioplankton (BP) production, and was dependent on soil nutrient composition. Increased nutrient availability associated with watershed inflow stimulated PP production in the water column euphotic layer. The presence of SSP did not significantly stimulate microheterotrophy. Highly turbid watershed runoff caused vertical displacement of PP cells in laboratory water columns and during runoff events in the lake. These results indicate ultra-PP and free-living bacteria are coflocculated in high SSP concentrations. In both laboratory and field studies, the PP-BP response to turbid inflow occurred in 3 district phases: light limitations of photosynthesis; partial removal of PP and bacteria from the water column by combined advective-vertical displacement; and nutrient stimulation of euphotic layer PP. An analogous sequence should occur in reservoirs having similar inflow characteristics. (Zielinski-MAXIMA)
W82-06710

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 855-862, June, 1982. 122 Ref.

Descriptors: *Literature reviews, *Sediments, *Fate of pollutants, *Metals, *Reviews, Sedimentation, Sediment transport, Sampling, Chemical analysis, Heavy metals, Nutrients, Organic compounds, Benthic fauna, Invertebrates, Model studies, Phos-

phorus, Nitrogen, Lake sediments, Reservoirs, Bacteria.

A review of recent papers on aquatic sediments includes analytical and sampling methods, heavy metals, nutrients, biological activity, organic pollutants, and modeling and sediment transport. Analytical methods described the use of neutron activation for trace metal analysis, a method for Be7 direct measurement, methods for simultaneous determination of 15 and 20 metals, and procedures for detection of Zn, Cd, Ca, Pb, Fe, Al, Hg, Ba, and Ra. Chromatography and/or mass spectrometry techniques were applied to determination of organic compounds. Sediment core sampling and sediment traps were the subject of several papers. Heavy metals investigations showed that suspended solids levels under estuarine conditions did not remove dissolved chromate from the water column. In a wastewater effluent receiving stream Mn remained dissolved, and other heavy metals were associated with the colloidal and particulate fraction. In uranium mine effluent Ba(Ra)S04 was a predominant particulate phase. Relationships between nutrients, especially P, and sediments were discussed. Release of nutrients from sediments was related to oxygen status, redoxpotential, and mineral phases. Investigations of biological activity in sediments included oxygen demand, activity of nitrifying organisms in different layers of a lake, metabolism of sediment bacteria under anaerobic conditions, bacterial degradation of organic pollutants in sediments, and effects of pollutants on benthic fauna. Case studies of organic pollution incidents and models for transport or organic compounds were discribed. Several sediment transport models concerned agricultural runoff, sediment yield from forested watersheds and streams, sediment behavior in reservoirs and lakes, and sediment-water exchange models. (Cassar-FRC)
W82-06806

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06858

CALCULATION OF CUMULATIVE PERCENTAGE AT SELECTED PARTICLE SIZES FROM BOTTOM WITHDRAWAL TUBE ANALYSIS,
Department of the Environment, Ottawa (Ontario). Computing and Applied Statistics Directorate.
C. S. Lam.
Water Resources Bulletin, Vol 18, No 3, p 525-528, June, 1982. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Particle size, *Suspended sediments, Computers, Sediments, *Oden curve, Mathematical studies, Statistical studies, *Sedimentation.

A new method is proposed for obtaining a single continuous Oden curve in a sediment particle size analysis. A time scale transformation is introduced, and the cumulative percentage of a selected particle size is analytically determined by cubic spline coefficients in the tangent intercept on the curve. Of the 124 tested samples, 113 samples could be fitted by a four-knot pline function. Six of the failed 11 samples could be fitted by a five-knot spline function. Three of the remaining 5 samples could be fitted by a five-knot spline function after deletion of one bad data point. Only two samples failed all attempts. The economy of this new approach over the manual graphical method is obvious. A more significant point is that the percent finer of a selected particle size is determined through a single continuous curve. The accuracy of the result obtained by averaging two approximated tangents of two overlapping segments, in which the continuity of the Oden curve is in question in the graphical method, is no longer an argument in the new approach. On a CYBER 74 computer, it took 14.15 seconds to calculate the equivalent percentages in a 100 cm high suspension of sediment and corresponding settling times for 124 samples from laboratory measured data. The calculation of percent finer at 15 selected particle sizes for all samples took 20.25 seconds. (Bakr-FRC)
W82-06873

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W82-06876

FIRE AND GEOMORPHIC PROCESSES,
F. J. Swanson.
In: Proceedings of the Conference on Fire Regimes and Ecosystem Properties, December 11-15, 1978, Honolulu, Hawaii, General Technical Report WO-26, Forest Service, Washington, D.C., June 1981, p 401-420, 4 Fig, 81 Ref.

Descriptors: *Fires, *Geomorphology, *Soil erosion, *Sediment yield, *Hydrology, *Vegetation, Sediment transport, Forest fires, Soil water, Overland flow, Sediment erosion, Accelerated erosion, Watershed management.

Fire alters vegetation and soil properties; these changes alter the hydrologic regime of a site with the collective effect of changing the movement of soil and sediment through watersheds. Interactions among fire, hydrology, and geomorphology vary with the time scale on which a landscape ecosystem is considered. On the short time frame of immediate effects of a single fire on hydrology and geomorphology, fire operates principally through alteration of vegetation and soil properties to alter hydrologic and geomorphic processes. The effects are generally increased soil water and overland flow which result in accelerated erosion by a variety of surface and mass movement processes. The contribution of fire-induced accelerated erosion to overall sediment yield can be assessed on the intermediate time scale of several fire rotations. Highly erosive landscapes with frequent, intense fire may have more than 70% of their long-term sediment yield exported during the period of accelerated erosion immediately following a fire. The magnitude of geomorphic effects of fire in an ecosystem depends on the frequency and intensity of fire, and the sensitivity of geomorphic systems to disturbance. Geomorphic sensitivity is controlled by hillslope and channel steepness and the effectiveness of vegetation in regulating physical processes. A variety of hydrologic and geomorphic features function as firebreaks. (Moore-SRC)
W82-06963

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,
Humboldt State Univ., Arcata, CA., Dept. of Geology.
For primary bibliographic entry see Field 4D.
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 4D.
W82-06971

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 8B.
W82-06990

2K. Chemical Processes

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W82-05990

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,
Central Electricity Research Labs., Leatherhead (England).
A. H. Webb.
Water Research, Vol 16, No 5, p 641-648, May, 1982. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Seasonal variation, *Chemical composition, *Acids, Tovdal River, *Norway, Physicochemical properties, Acid rain, Nitrates, Sulfates, Chlorides, Aluminum, Silica, Snowmelt, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium, Ammonium, Water analysis, Leaching, Organic carbon.

Chemistry of water in the Tovdal River, Norway, was investigated by analysis of weekly samples from August 1978 to December 1979. The pH varied slightly over the study period, 4.64 to 5.14, and was lowest in winter. Concentrations of both the air pollution derived species (sulfates, nitrates, and ammonium) and groundwater derived minerals (Ca, Mg, and K) increased steadily in river water during summer and winter to a broad peak during spring and decreased to a minimum in summer. The rapid metabolism of nitrate and ammonium produced some irregularities in their patterns. The broad peak in spring of the acid rain constituents (sulfates and nitrates) coincided with the peak in alkalis because of leaching from the ground during the snowmelt period. Sulfate levels were higher in the fall of 1979 than in the fall of 1978, alkalis were lower, and therefore pH was lower. Total weak acid concentrations (silica, Al, and ammonium) also showed spring maximums and summer minimums. These were correlated with total organic carbon concentrations, but the inorganic weak acid species largely controlled the seasonal variations in weak acid content. (Cassar-FRC)
W82-06052

A FAUNAL ANALYSIS OF THE SPRINGS OFF THE OUACHITA MOUNTAINS, ARKANSAS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
H. W. Robison.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254871, Price codes: A03 in paper copy, A01 in microfiche. Publication No 83, September 1981. 33 p, 1 Fig, 3 Tab, 39 Ref. OWRT A-047-ARK(1). 14-34-0001-9004.

Descriptors: Benthic Fauna, *Aquatic animals, *Springs, *Microinvertebrates, Surveys, Fauna, Aquatic life, Aquatic habitats, Aquatic populations, Aquatic soils, Aquatic environment, Ecosystems Isopods, Crustaceans, Amphipods, Caddisflies, Aquatic insects, Calcium Carbonate, *Arkansas, Ouachita Mountains, Pollutant identification.

A faunal survey was made of 33 spring ecosystems in a 135 by 80 km study area in the Arkansas Ouachita Mountains physiographic province, extending west from Hot Springs to the Oklahoma line. Springs in this province were characterized as being generally faunistically-poor, with often only a single species (e.g., the isopod, Lirceus H. hoppinae) being the dominant faunal element with respect to both numbers and biomass. A total of 40 invertebrate species and eight vertebrate species were collected from the spring environs during the course of the study; five additional invertebrate species (two amphipods, three caddisflies) were discovered from a detailed literature search, making a total finding of 53 aquatic invertebrate and vertebrate species that characterize the springs in this mountain physiographic province. Water quality of the springs is characterized as potable, with calcium (calcium bicarbonate) as the major element due to the widespread distribution of limestone and calcaeous cements throughout the area of study. An annotated list of the 45 benthic macroinvertebrates and eight vertebrates collected in this survey is provided. (Zielinski-MAXIMA)
W82-06161

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W82-06179

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
D. H. Loring.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 930-944, May, 1982. 3 Fig, 7 Tab, 28 Ref.

Descriptors: *Sediments, *Heavy metals, *Path of pollutants, *Bay of Fundy, Zinc, Copper, Lead, Cobalt, Nickel, Chromium, Vanadium, Mercury, Beryllium, Arsenic, Barium, Selenium, Bays, *Canada.

This study reports on the sedimentological, mineralogical, chemical and anthropogenic factors that control the sedimentary abundances and gradients of zinc, copper, lead, chromium, vanadium, cobalt, nickel, mercury, beryllium, arsenic, barium and selenium as well as an estimation of the potential bioavailability of zinc, copper, lead, cobalt, nickel, chromium, and vanadium in the fundy sediments. Sediment samples were collected at 100 locations. Total Zn, Cu, Pb, Co, Ni, Cr, V, Be, Hg, As, Se, and Ba concentrations varied regionally and with textural differences in the sediments. Except for local anomalies, the concentrations are at or near natural levels when compared with texturally equivalent sediments from unpolluted areas of the eastern Canadian coastal areas. The nature, grain size, and abundance of the metal-bearing minerals, amorphous compounds, and organic matter are the main factors controlling the metal gradients in the bay of Fundy. Of the total metal content, 73-99% is not readily available to the biota but is held in various sulfide, oxide and silicate minerals. The host minerals have accumulated at the same rates as other detrital material, except for particles of zinc oxide that have been derived from industrial sources adjacent to the bay. Relatively high metal concentrations did occur near a dredge dispersal site off St. John Harbor and may reflect the initial impact of anthropogenic inputs on the natural levels of metals in the Fundy sediments. (Baker-FRC)
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W82-06190

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 5B.
W82-06245

THE POTENTIAL ACIDITY ASSOCIATED WITH DEWS, FROSTS, AND FOGS,
Flow General Inc., McLean, VA.
J. Wisniewski.
Water, Air, and Soil Pollution, Vol 17, No 4, p 361-377, 1982. 3 Fig, 1 Tab, 51 Ref.

Descriptors: *Acidity, *Condensation, *Frost, Chemical composition, *Fog, *Dew, *Pollutant identification, Precipitation, Chemical analysis, Corrosion, Vegetation effects.

In general special events of dews, frosts, and fogs are the result of water vapor condensation or sublimation in the layers of the atmosphere closest to the ground. The meteorology of these special events is briefly reviewed, including mechanisms of their formation as well as their frequency of occurrence. While research into the chemistry of the water involved in these special events is sparse, there is direct and indirect evidence available which indicates a potential acidity. The chemistry of this water is primarily dependent on two factors. The first is the amount and type of material absorbed by dew and fog directly from the atmosphere. The second controlling factor is the presence of substances, on the surface of which the moisture is deposited. The source of most of these materials is dry deposition of natural and anthropogenic substances from the atmosphere, including soil particles, fly ash, pollen, microbes, trace metals, aerosols, and adsorbed gases. Values of pH associated with these events have been observed to be below 3.0 for fog. Theoretical calculations indicate that synergistic acidity from dew combined with previous acidic dry deposition may result in pH values of less than 2.0. Neutralization due to leaching of plant metabolites or surface reactions on contact could raise the pH, but either of these two processes would damage the plant or material surface in question. (Baker-FRC)
W82-06246

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,
Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts.
Water Research, Vl 16, No 7, p 1273-1276, July, 1982. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water analysis, *Spectrophotometry, Metals, Iron, Aluminum, Manganese, *Humic acids, *Tannic acids, *Lignosulfonic acids, Organic compounds, Chemical analysis, Chemical reactions, Natural waters, *Metal ions.

A study was conducted to assess the consequences of metal-organic interactions on the quantification of fulvic acid, tannin and lignin in natural waters. Solutions were prepared so that the final concentrations of humic acid, tannic acid and lignosulfonic acid were each 5.00 ppm. Ferric iron was added to individual solutions to final concentrations of 0.0, 0.1, 0.5, 1.0, and 5.0 ppm. Changes in the ultraviolet spectra of the three acids as a function of increasing iron concentration wre demonstrable. In all cases the highest iron concentration showed the dominance of the iron spectrum. At lower iron concentrations it was apparent that the spectral alterations occurring for humic acid and lignosulfonic acid were different from those for tannic acids. While the spectra of both humic acid and lignosulfonic acid in the presence of ferric iron appear to be additive with that of the metal, the spectral changes of the tannic acid in the presence of ferric iron show a dimunution of the peak height at 280 nm with the attendant appearance and increase of a shoulder in the spectra at 320-340 nm. These changes indicate alteration of the electron configuration due to interaction with the iron either through complexation or due to steric considerations. These findings suggest that the concentrations of metals in natural waters are important when attempting to determine the concentrations of humic or fulvic acids, tannins and lignin in natural waters using a method based on ultraviolet spectrophotometry. (Baker-FRC)
W82-06273

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,
Foras Forbartha, Dublin (Ireland).
For primary bibliographic entry see Field 5A.
W82-06314

TRACE METAL RELATIONSHIPS AT THE SEDIMENT-WATER INTERFACE,
Vermont Univ., Burlington. Dept. of Geology.
J. C. Drake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256561, Price codes: A05 in paper copy, A01 in microfiche. Report, December, 1980. 77 p, 5 Fig, 1 Tab, 75 Ref, 1 Append. OWRT A-039-VT(1).

Descriptors: *Trace metals, *Sediment-water interfaces, *Chemical analysis, *Chemical stratification, *Sediments, Interstitial water, Phosphorus, Copper, Lead, Water quality control, Water quality, Organic matter, Trace elements, Trace levels, Toxicity, Metals, Chemical properties, Water analysis, Chemical composition, Mud-water interfaces, Cores, Bays.

Interstitial waters from nine cores of near-surface sediments from four bodies of water were analyzed for trace elements (reactive phosphorus, (P), iron, manganese, copper (Cu), lead (Pb), titration alkalinity, wet sediment porosity and redox potential, to assess the capability for chemical exchange at the sediment-water interface. Only Pb and Cu did not show significant enrichment in pore waters relative to overlying lake waters. Iron generally increased with depth; P often showed more than one peak concentration with depth. The data indicated that pore water chemistry differed significantly among samples from various sites, caused by organic matter decomposition. Diffusion of Cu and Pb out of the sediments is not considered significant, but bottom sediments constitute an enormous reservoir of chemically mobile iron, manganese and P which could potentially be released into overlying lake waters (especially when surface sediments become anoxic). St. Albans Bay P chemistry should be studied further, due to the extremely high concentrations of P in interstitial waters and the very low redox potential observed for St. Albans Bay surface sediments. (Zielinski-MAXIMA)
W82-06362

OCCURRENCE OF FLUORIDE BEARING GROUNDWATERS AND THEIR RELATIONSHIP WITH WATER TABLE FLUCTUATIONS,
Andhra Univ., Waltair (India).
V. V. J. Sarma, and A. N. Swamy.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 77-81, February, 1981. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Fluorides, *Groundwater, *Water table fluctuations, Water quality,Chemical composition, Apatite, Seasonal variation, Wells, Shallow wells, Visakhapatnam Basin, India, *Pollutant identification.

A 12-month study of fluoride levels in 130 shallow wells up to 60 ft deep in the Visakhapatnam Basin India, showed that the fluoride content of the water was maximal during the season of minimum water table in February-May and minimal during October when the water table was highest. For example, water in Well 43 varied from 5.0 to 8.0 ppm fluoride and water in Well 23 varied from 0.6 to 1.8 ppm fluoride. The designation of isofluores, lines of equal fluoride content, clearly located possible areas of fluoride bearing minerals, probably apatite. (Cassar-FRC)
W82-06443

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
E. Michnowsky, L. M. Churchland, P. A. Thomson, and P. H. Whitfield.
Water Resources Bulletin, Vol 18, No 1, p 129-132, February, 1982. 1 Fig, 12 Ref.

Descriptors: *Measurement techniques, *Metals, Water analysis, *Sample preservation, Water sampling, Suspended sediments, Trace metals, *British Columbia, Fraser River.

Although acidification is a common method used for the preservation of river and estuarine water samples collected for metal analysis, the effect of such treatment when high levels of suspended sedi-

ments are present has not been evaluated. Water samples with high concentrations of suspended sediments were collected from the Fraser River in British Columbia, Canada. These samples were acidified on site, taken to the laboratory, and analyzed for concentrations of extractable copper, zinc, lead, cobalt, cadmium, manganese, nicke, and iron at various intervals of over a 6 month period. The metal concentrations in these water samples were found to be unstable, with the concentrations of extractable metals generally increasing during storage. The largest increases in concentration typically occurred between 10 and 40 days. Many of these metals maintained a constant concentration during the first week of storage and/or after 100 days. These results indicate that the extractable metal technique is not suitable for analysis of water samples containing suspended sediments, since it is not restrictive enough to ensure reproducible results. Comparisons between samples stored for varying periods of time would also not be reliable. (Carroll-FRC)
W82-06630

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,
Plymouth Polytechnic (England). Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W82-06668

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,
State Univ. of New York, Syracuse. Dept. of Civil Engineering.
C. T. Driscoll, and G. E. Likens.
Tellus, Vol 34, No 3, p 283-292, June, 1982. 4 Fig, 37 Ref.

Descriptors: *Hydrogen ion concentration, *Forests, Ecosystems, Aluminum, Nitric acid, Sulfuric acid, Acidity, Precipitation, Water quality, *New Hampshire, Forest watersheds.

A detailed evaluation was made of the hydrogen ion budget for the Hubbard Brook Experimental Forest in West Thornton, New Hampshire. Hydrogen ion sources were found to approximately balance hydrogen ion sinks. Atmospheric hydrogen ion inputs contributed 52% of the total hydrogen ion sources for the ecosystem. Based on this budget, projections of changes in precipitation hydrogen ion loading on water quality were made. To make such prediction it was necessary to make some assumptions concerning the response of a forested ecosystem to increases and decreases in atmospheric hydrogen ion inputs. To estimate changes in water quality due to changes in hydrogen ion loading, a modified chemical equilibrium model was used. The model was incrementally titrated with strong acid or strong base corresponding to the incremental change in hydrogen ion loading. Three changes in precipitation loading of hydrogen ion to the ecosystem were examined. These changes were made as nitric acid, as sulfuric acid, and as a combination of nitric and sulfuric acids, corresponding to the ambient stoichiometry in precipitation. The magnitude of these hydrogen ion loading changes ranged from a 50% increase to the lowest possible decrease based on the concentration of nitrate and sulfate in ambient precipitation. The form of the acid input is important in the response of stream water quality to changes in hydrogen ion inputs. Another important consideration is the role of aluminum in the buffering of hydrogen ion in this ecosystem. (Baker-FRC)
W82-06836

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2D.
W82-06850

STABILITY OF BETA-MNOOH AND MANGANESE OXIDE DEPOSITION FROM SPRINGWATER,
Geological Survey, Menlo Park, CA.
J. D. Hem, C. E. Roberson, and R. B. Fournier.
Water Resources Reseearch, Vol 18, No 3, p 563-570, June, 1982. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Natural waters, *Manganese oxides, *Chemistry of precipitation, Chemical reactions, Spring water, Springs, Chemical composition, Thermodynamics, *Oxidation-reduction potential.

Beta-MnOOH is precipitated preferentially at temperatures near zero degrees C when Mn(2+) is oxidized in aerated aqueous solutions. On aging in solutions open to the atmosphere a slurry of beta-MnOOH tends to disproportionate to form manganese dioxide and MN(2+). In such aged solutions, Mn(2+) and H(+) activities can be constant and both the oxidation reaction and the disproportionation reaction can have positive reaction affinities. It is not possible for both reactions to be in thermodynamic equilibrium in the same system unless oxygen is almost completely absent. Analytical data for manganese-depositing springwater samples are consistent with a nonequilibrium model involving disproportionation of either beta-MnOOH or Mn304. (Baker-FRC)
W82-06862

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,
Florida University, Gainesville School of Forest Resources and Conservation.
For primary bibliographic entry see Field 5C.
W82-06901

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,
Alaska Univ., Fairbanks, Inst. of Marine Science.
For primary bibliographic entry see Field 5A.
W82-06931

2L. Estuaries

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-05984

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06050

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-81/55, March 1982, Wahington, DC. 81 p, 29 Fig, 14 Tab, 154 Ref.

Descriptors: *Salt marshes, *Ecology, *Tidal marshes, *Environmental effects, Marsh management, Sediments, Tidal effects, Sea level, Vegetation, Productivity, Land use, Flooding, Drainage, Mosquitos, Pollutants, Sludge.

The high salt marshes of New England have evolved in response to sea-level rises through accretion of sediments entrapped by marsh vegetation. The shape and appearance of high marshes result from unique, complex interactions of local topography and bathymetry, sea level rise, tides, sediment supply and vegetation. These factors particularly the major influences of tides and short-term changes in sea-level, are incorporated in short-term processes that define and mold the ecology of the high marsh. Short-term and long-term mechanisms have produced approximate zonation of vegetation in the high marsh. High marshes are contrasted to Spartina-dominated low marsh in terms of plant and animal species and the relative importance of the dynamics of production, export, decomposition, and accumulation of materials in the sediments. Since the mid 1600's, the marshes in New England have been flooded or drained, impounded or diked, ditched or filled. High marshes have been used as hay fields. Ditching for mosquito control has affected a large part of the New England high marshes. Human activities have polluted the marshes with metals, oil chemicals, and trash. Habitat management considerations today include mosquito control and sewage sludge treatment. (Moore-SRC)
W82-06096

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center.
For primary bibliographic entry see Field 2J.
W82-06189

RETENTION OF RIVERINE IRON IN ESTUARIES,
Maine University at Orono, Walpole.
For primary bibliographic entry see Field 5B.
W82-06191

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 5B.
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 203, January, 1980. Council for Scientific and Industrial Research, Pretoria, South Africa. 122 p, 15 Fig, 57 Tab, 17 Ref, 3 Append.

Descriptors: *Trace metals, *Chemical analysis, *Water analysis, *Pollutant identification, *Water pollution sources, Trace elements, Trace levels, Lagoons, Estuaries, South Africa, Water quality, Environmental quality, Sediment-water interfaces, Heavy metals, Pollutants, Rivers, Nonpoint pollution sources, Sediments, Cores, Metals, Water quality control, Surveys, Atomic absorption spectroscopy.

Detailed surveys undertaken during 1975-78 to study the trace metal content of the Knysna River and Lagoon are summarized. Surface sediment, water, and sediment core samples were taken over an 11.5 sea mile distance, and analyzed by atomic absorption spectroscopy for 16, 13, and 16 elements, respectively. Interelement relationships and absolute metal concentrations were examined prior to data interpretation. Water salinity was also measured at certain sites, and biological material was taken from the Heads region and analyzed for 9 elements. The results indicated the presence of specific sites of metal input into the Lagoon and the distribution of drains/seepages which also contaminate the area. The metal concentrations found, however, were generally low, and such anomalies as do occur appear to be transitory in nature since little metal accumulation was found to occur in the sediment column. The area cannot be strictly considered as polluted, although certain metal concen-

trations were elevated above true background values as determined for other southeastern Cape estuaries. Metal concentrations in biological material from Knysna estuary were much lower than many of the reported values for the material species, indicating that the estuary is unpolluted by zinc, cadmium, copper, iron, manganese, and nickel. (Zielinski-MAXIMA)
W82-06388

STATISTICAL SEARCH FOR HIGH WATER AT BOARD LANDING BRIDGE, TRURO, NOVA SCOTIA,
G. Godin, P. A. Bolduc, D. G. Mitchell, and S. Yuen.
Marine Sciences and Information Directorate, Manuscript Report Series No 58, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 43 p, 7 Fig, 7 Tab, 7 Ref, 1 Append.

Descriptors: *Prediction, *Mathematical studies, *Tides, *Correlation analysis, *High water mark, *Bridges, Statistical methods, Probability distribution, Tidal waves, Tidal amplitude, Tidal currents, Forecasting, Water level fluctuations, Model studies, Regression analysis, Computer programs.

In order to obtain an estimate of the height of the high water at a Nova Scotia bridge, a statistical search was made of the two-year data of tidal observations at the bridge. Strong shallow-water distortion in the area precluded the use of a direct harmonic analysis; therefore, correlations were calculated between the time of travel of high water to the bridge and its height there against the high water height of nearby reference stations. The random portion of the signal was evaluated following a regression analysis with Saint John and other stations. The predicted height of high water at Saint John gave the best fit, suggesting a coupling between non-tidal events at the two sites. A height of 33.3 feet with a return period of about 90 years was inferred from the results. In order to check on the recurrence interval of extreme tides in the Bay of Fundy, 100 years of predictions covering the interval of 1981-2080 for Saint John were prepared. Further, it is felt that studies on the dynamics of Minas Basin will eventually have to be undertaken; to a good first approximation, the Basin may be viewed as being cut off from the Bay of Fundy as far as disturbances are concerned. (Zielinski-MAXIMA)
W82-06394

MINERALIZATION OF DETRITAL LIGNOCELLULOSES BY SALT MARSH SEDIMENT MICROFLORA,
Georgia Univ., Athens. Dept. of Microbiology.
A. E. Maccubbin, and R. E. Hodson.
Applied and Environmental Microbiology, Vol 40, No 4, p 735-740, October, 1980. 2 Fig, 2 Tab, 28 Ref. OWRT A-082-GA. 14-34-0001-9011.

Descriptors: *Pine trees, *Salt marshes, *Microorganisms, Carbon cycle, Mineralization, *Degradation, Carbon, Detritus, *Lignocelluloses.

The rates of degradation of specifically radiolabeled, extractive-free lignocelluloses from S. alterniflora and Pinus elliotii were determined in incubations approximating conditions in the aerobic surface layers of various marsh and estuarine habitats. The pine lignocellulose was included as it is a lignocellulose of terrestrial origin that is likely to be transported into the estuarine environment by stream runoff. A 10- to 14-fold difference was found in the rates of mineralization of the lignin moieties of lignocelluloses from S. alterniflora and P. eliottii, which was probably indicative of basic structural differences between the lignins of grasses and gymnosperms. Data collected confirmed the widely held assumption that lignocellulose accounts for a large percentage of the standing stock of plant material in salt marsh estuaries. Knowledge of thee factors controlling rates of lignin and cellulose degradation in marsh and coastal sediments can enhance the understanding of carbon flow in detritus-based systems. This will have wide applicability in studies of microbial processes in marsh-dominated coastal marine environments. (Small-FRC)
W82-06410

VEGETATION STRUCTURE AND DIVERSITY COMPONENTS OF A FRASER ESTUARY TIDAL MARSH,
British Columbia Univ., Vancouver. Dept. of Botany.
G. E. Bradfield, and G. L. Porter.
Canadian Journal of Botany, Vol 60, No 4, p 440-451, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Estuaries, Vegetation, *Tidal marshes, *Species diversity, *Marsh plants, Tidal rivers, Species composition, Tidal floods, Drainage effects, Community development, *Fraser River estuary, *British Columbia.

Vegetation data from a predominantly freshwater-influenced tidal marsh near the mouth of the Fraser River in southwestern British Columbia were analyzed to examine compsitional variation in the vegetation in relation to inferred gradients of tidal flooding and drainage. Another goal of the study was to evaluate various diversity components of marsh vegetation types and assess their value for heuristic investigation of vegetation-environment relations in tidal marsh ecosystems. Three main vegetation zones were recognized. Regularly flooded and drained sedge areas were dominated by Carex lyngbyei. A grass-willow zone along the crests of infrequently flooded levees was dominated by Festuca arundinacea. A mixed-forb zone in areas of poor drainage where the water table remained permanently high was dominated by Menyanthes trifoliata. Principal components analysis and reciprocal averaging gave similar results except for a 90 degree rotation of ordination axes. The combined results from cluster analysis and ordination provided a useful summary of the marsh vegetation structure and a useful background for making comparisons and evaluating factors that affect community development. (Geiger-FRC)
W82-06465

VEGETATION-ENVIRONMENT RELATIONS IN A BRACKISH MARSH, LULU ISLAND, RICHMOND, B.C.,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
I. Hutchinson.
Canadian Journal of Botany, Vol 60, No 4, p 452-462, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Marsh plants, *Succession, *Species diversity, *Estuaries, Brackish water, *Tidal marshes, *Salinity, Ecology, Species composition, Salt marshes, Tide lands, Interstitial water, Marine sediments, Fluvial sediments, Elevation, British Columbia.

The relationship between plant species distribution and the physical factors of submergence, pore water salinity, sediment texture, and substrate water content was examined in the foreshore marshes of Lulu Island in the Fraser River delta. Analysis of tidal records revealed three elevational zones - a low marsh dominated by two Scirpus species, a middle marsh dominated by Carex lyngbyei, Triglochin maritimum and S. maritimus, and a high marsh community with four dominant plant species. Results of an analysis of variance procedure showed that elevation and elevation-salinity interactions were the main factors controlling plant distribution. Substrate texture and moisture content were significantly associated with variations in species abundance. The Lulu Island marshes are similar in flora and ecology to estuarine and deltaic marshes of Oregon and Washington and are influenced by fluvial regimes which affect salinity and sediment characteristics. (Geiger-FRC)
W82-06497

VARIABILITY OF TEMPERATURE, SALINITY AND TIDALLY-AVERAGED DENSITY IN THE MIDDLE ESTUARY OF THE ST. LAWRENCE,
Bayfield Lab. for Marine Science and Surveys, Burlington (Ontario).
L. R. Muir.
Atmosphere-Ocean, Vol 19, No 4, p 320-336, 1981. 4 Fig, 4 Tab.

Descriptors: *Mixing, *Temperature, *Salinity, Tidal effects, Tidal energy, Estuaries, Water temperature, Density, *St. Lawrence Estuary, Statistical analysis, Ontario, *Path of pollutants.

Variations in temperature (T), salinity (S), and density of water in the Middle St. Lawrence Estuary between Riviere du Loup and St. Roch were complex. Surveys produced 15,000 T-S pairs distributed over 62 13-hour profiling stations. The T-S curves at each station were linear, but it was impossible to relate temperature and salinity over the whole Middle Estuary for a month or two. The lack of correlation could not be explained in terms of linear combinations of the parameters for location in the estuary, the upstream water properties, the phase of the spring-neap tides, and the tidal energies. The tidally-averaged density structure was separable into horizontal and vertical components. The vertical variation over the whole estuary was explained by any one of three functional forms, but the horizontal variation was not explicable by any linear combinations of the parameters previously mentioned. Plots of horizontal variations in temperature, salinity, or density are not meaningful unless data are collected synoptically and over a period longer than one tidal cycle. Although the mixing process in the estuary appeared conservative and linear at a given instant in space and time, it was non-linear over space and time. (Cassar-FRC)
W82-06533

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,
Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06534

SEASONAL VARIABILITY AND TRANSPORT OF SUSPENDED MICROFUNGI IN A SOUTHEASTERN SALT MARSH,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Science and Coastal Research.
T. H. Chrzanowski, L. H. Stevenson, and J. D. Spurrier.
Applied and Environmental Microbiology, Vol 43, No 2, p 392-396, February, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Salt marshes, *Fungi, *Seasonal variation, Microorganisms, Suspended load, Water currents, Estuaries, Bioindicators, *Path of pollutants, Water pollution sources.

Microfungi are potentially useful as indicators of water mass movements and resuspension in estuaries and salt marshes. As part of a continuing investigation of their usefulness for this purpose, tidally induced and seasonal variations of suspended microfungi concentrations were assessed and the presence of microfungi in water exiting from a salt marsh was studied. Samples were collected at three depths from three stations positioned at a transect in a large salt marsh creek in South Carolina. Samples were taken every 1.5 hours for 50 consecutive hours during neap tides and for 50 consecutive hours during the corresponding spring tides. Microfungi concentrations were found to be relatively consistent from season to season. Tidally induced variability was more dramatic, with microfungi concentrations fluctuating out of phase with the tidal rhythm during both neap and spring tides. Over 90% of the tidal cycles monitored showed a net movement of microfungi out of the marsh, indicating that the microfungi should be useful in tracing a water mass after it has exited a marsh. These study results suggest that seasonal variations in the concentrations of suspended microfungi should not limit their usefulness as water mass indicators in salt marsh environments. (Carroll-FRC)
W82-06536

SULFATE REDUCTION AND METHANOGENESIS IN THE SEDIMENT OF A SALTMARSH ON THE EAST COAST OF THE UNITED KINGDOM,

Essex Univ., Colchester (England). Dept. of Biology.
E. Senior, E. B. Lindstrom, I. M. Banat, and D. B. Nedwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 987-996, May, 1982. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salt marshes, *Chemical reactions, *Sulfate reduction, Marshes, Tidal marshes, Acidity, Sulfates, *Methanogenesis, Sediments, *England, Estuaries, Coastal waters, Coastal marshes.

A program of regular field sampling was initiated in the Colne Point salt marsh, Essex, United Kingdom. The main objectives of the program were to determine whether any spatial or temporal separation(s) between sulfate reduction and methanogenesis were apparent which might explain their coexistence, to determine the annual magnitudes of each process, and to investigate some of the environmental variables which might significantly influence the processes. These two processes are the major terminal oxidation steps in the flow of carbon and electrons in anaerobic environments. The rate of sulfate reduction, methanogenesis, and methane loss were measured in salt marsh sediment at monthly intervals. In addition, dissolved methane and sulfate concentrtions together with pS(2-) and pH were determined. Methane formation from carbon dioxide, but not from acetate, was detected within the same horizon of sediment where sulfate reduction was most active. Sulfate reduction was about 3 orders of magnitude greater than annual methanogenesis. The two processes were not separated either spatially or temporally, but occurred within the same layer of sediment at the same time of the year. Their coexistence did not seem to be the result of sulfate-depleted microenvironments within which methanogenesis could occur, but the methanogenic bacteria persisted at very low rates of activity within the same environment as the sulfate reducers. The observed discrepancy between in situ methanogenesis and methane loss from the sediment surface was interpreted as a real phenomenon, possibly due to methanogenesis from substrates other than acetate or bicarbonate. (Baker-FRC)
W82-06541

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
G. P. Steven.
Advances In Water Resources, Vol 5, No 1, p 29-34, March, 1982. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Finite element method, *Interfaces, *Boundaries, Model studies, Fate of pollutants, Mixing, Stratification, Thermal pollution, Mathematical studies.

Restructuring of coefficient matrices of a finite element solution gave good results for problems in which physical parameters had discontinuities at the interfaces. In this work one-dimensional model studies were done using four schemes for accommodating a moving interface across which there are discontinuities in physical parameters. The effective schemes were: development of a special element which allowed the interface to move across it, and using an adaptive grid so the interface always remained at an element boundary. However, only the first was suitable for use in two- and three-dimensional problems. These solutions may be applied to problems such as salt-fresh water interaction in an estuary, stratification in water bodies, thermal outputs from power stations, sewage discharges, and injection of one fluid into another. (Cassar-FRC)
W82-06546

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,
Plymouth Polytechnic (England). Dept. of Marine Science.
G. E. Millward, and R. M. Moore.
Water Research, Vol 16, No 6, p 981-985, June, 1982. 4 Fig, 1 Tab, 34 Ref.

Descriptors: *Estuarine environment, *Trace metals, Estuaries, *Copper, *Manganese, *Zinc, *Iron, Model studies, *Adsorption, Acidity, Salinity, Chemical reactions.

The sorption of behavior of copper, manganese and zinc on to freshly precipitated iron oxyhydroxide was investigated as a function of acidity and salinity, in order to more fully understand the behavior of these metals in estuaries. In distilled water the acidity of the onset of adsorption was in increasing order from Cu, Zn to Mn, which qualitatively follows the hydrolysis of the metals in the bulk solution. The pH of the adsorption edges could not be quantitatively predicted from the hydrolysis data, and it is necessary to resort to the use of surface complexation constants for cation adsorption. The hypothesis of metal uptake involving coulombic interactions between the precipitate and the metal species in solution did not fit the observations, and it was concluded that a detailed knowledge of surface complexation reactions was needed, as is shown for copper. The adsorption isotherms for copper were independent of salinity while those for zinc and manganese showed an increase in the pH of the adsorption edge with increases in salinity. It was suggested that the major cations of calcium and magnesium were probably co-adsorbed, and competition from these species for adsorption sites increased with increasing salinity. These results will aid in the development of predictive models for the fate of trace metals injected into estuarine systems, where iron compounds may be freshly precipitated. (Baker-FRC)
W82-06668

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,
Univerity of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06742

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5C.
W82-06748

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,
Rostock Univ. (Germany, D.R.).
For primary bibliographic entry see Field 5C.
W82-06763

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,
Institute fuer Meeresforschung (Germany, D.R.).
For primary bibliographic entry see Field 5B.
W82-06766

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,
Virginia Inst. of Marine Science, Gloucester Point.
D. Hayward, C. S. Welch, and L. W. Haas.
Science, Vol 216, No 4553, p 1413-1414, June 25, 1982. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Destratification, *Estuaries, Estuarine environments, Coastal workers, Rivers, Bays, Chesapeake Bay, *York River, *Salinity, Saline water intrusion, Stratification, Seasonal variations, Tidal rivers, Tides, Tidewater, *Virginia.

Desratification in the York River was investigated. A conceptual model for the onset and disappearance of vertical homogeneity was developed from a examination of salinity data collected during intensive studies of two destratification events that were predicted on the basis of earlier work. The intrusion of relatively fresh water, which initiated the destratification process, is indicated by the sharp downward displacement of isohalines on 16 August 1978 and 26 August 1980. In each case this was followed by a progressive reduction of stratification in the water column. The introduction of fresher water into the river mouth caused a reversal of the longitudinal salinity gradient, producing a midriver salinity maximum. The assumption is made that the salinity changes at the station are caused in large part by the advection of water of differing salinity up and down the river by tidal currents. Depressions in the isohaline, indicating the presence of freshwater water, coincide with slack before ebb through 28 august, the data of greatest tidal heights. After that date the isohaline at 23 per mil showed a phase reversal. The depressions are coincident with slack before flood, indicating the reestablishment of the normal longitudinal salinity gradient. While tidal heights were increasing, there was a continuing source of fresher water. As tidal heights reached, more saline water was once again present in the river mouth. The Chesapeake Bay was the only reasonable source for the relatively fresh water. The tidally synchronized advection of the relatively freshwater into the river mouth during sufficiently strong spring tides occurs as a result of the relationship of the tidal current phases of the river and the bay. During neap or mean tidal cycles the tidal excursion is insufficient to introduce relatively fresh water into the river. (Baker-FRC)
W82-06787

A STEADY STATE MODEL FOR BUOYANT SURFACE PLUME HYDRODYNAMICS IN COASTAL WATERS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Tellus, Vol 34, No 3, p 293-306, June, 1982. 11 Fig, 14 Ref.

Descriptors: *Coastal waters, *Plumes, Model studies, Hydrology, Hydrodynamics, Flow characteristics, Fluid mechanics, Buoyancy, *Connecticut River, *Long Island Sound, *Steady flow.

The horizontally two-dimensional, steady flow problem posed by the discharge of a shallow layer of buoyant fluid from an outlet channel at a coast into an unbounded domain of ambient water having uniform alongshore motion has been modeled. An ambient current is a necessary conditions for a steady state, since in its absence time dependent spreading of the buoyant layer would continue indefinitely. Thus the problem includes the basic features of horizontal gravitational spreading, frontal boundaries, and an ambient current. In this model earth rotation was neglected. Frontal jump conditions developed in an earlier paper were applied to match the flow at the frontal boundary with the remainder of the plume. Numerical solutions for the entire flow are found by the method of characteristics, but much of the flow can be determined by simpler analytic computation. The computed flow fields show that a frontal boundary forms on the upstream or offshore side of the plume, where the oncoming ambient current contains the gravitational spreading of the buoyant water. No front forms on the corresponding downstream, inshore side. In the body of the plume the flow simultaneously expands and turns downstream toward alignment with the ambient current. Relatively little change in plume water speed occurs, but the pressure field required for turning the flow downstream results in deepening of the plume interface offshore near the front. This in turn concentrates the plume volume flux along its offshore side near the front. The maximum angle through which the flow may be turned initially is less than 66 degrees. Outlet channel angles greater than this produce plumes which are separated from the shoreline by ambient water. The model results explain many of the observed features of the Connecticut River plume in Long Island Sound. (Baker-FRC)
W82-06837

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,
Lancaster University (United Kingdom). Department of Biological Sciences.

For primary bibliographic entry see Field 5C.
W82-06944

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION DIRECTORY 1981.
Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-248709, Price codes: A12 in paper copy, A01 in microfiche., Desalination, Vol 37, No 1, 2, May 1981. 255 p. OWRT C-90414-T(No 0401)(1).

Descriptors: *Desalination, *Water treatment, *Information exchange, *Technology transfer, *International commissions, Desalination plants, Desalination wastes, Desalination apparatus, Pretreatment of water, Clarification, Information systems, Documentation, Technology, Organizations, Industrial plants, Water use.

A first edition of an international directory of participants involved in desalination and water purification is presented. This directory should serve as a central tool to enhance communications among members of the world-wide desalting community. Overviews of activities in desalination and water purification are provided by individuals, organizations, and companies listed in the directory. The directory, hence, provides a useful information network for technology transfer in the desalination and water purification areas. Directory entries are both by alphabetical and geographical listings. A separate alphabetical listing of individuals, their affiliations, and addresses, is also included. Owing to the limitations encountered in preparing an initial directory, the narrative entries reflect the nature and scope of the organizations providing information, but are not necessarily proportional to the size, importance, or level of excellence of the organizations. This first edition also will serve as a checklist so that companies, institutions, and individuals can check their entries on their own merit and in relation to each other. A second edition, under preparation and planned for release in 1-2 years, will also include interests and society memberships of individuals, and a subject index. (Zielinski-MAXIMA)
W82-05908

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,
Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 1A.
W82-05910

TWO-PHASE FLOW THERMOSIPHONING FOR EVAPORATOR APPLICATION,
Westinghouse Research Lab., Pittsburgh, PA.
T. E. Lippert, J. M. Cardito, and R. M. Chamberlin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243403, Price codes: A04 in paper copy, A01 in microfiche. Final Report, January 1974. 53 p, 10 Fig, 12 Tab, 5 Ref, 1 Append. OSW (No 2880)(1), 14-30-2880.

Descriptors: *Saline water, *Thermosiphoning, *Evaporators, *Desalination apparatus, Design criteria, flow profiles, Photography, Laminar flow, Theoretical analysis, Mechanical engineering, Siphons, Process control, Water treatment, *Flash evaporation, Performance evaluation, Desalination, Water use, Water treatment.

Operation of an 11-foot long, 6-inch diameter thermosiphon was assessed, covering the two-phase flow-regime, determination of thermosiphon performance with regard to various system operating and design parameters, and a comparison of the resultant data with an existing homogeneous flow theory. Data were obtained on tap water, tap water with surfactant, and tap water with sea-salt. The results of this assessment demonstrated that the thermosiphon performed in a stable manner over the range of operating conditions examined. The predominant flow regime was churn bubbly, and was found to be essentally independent of the operating test conditions. High-speed movies clearly showed the character of the chugging action of the flow: the flow did not reverse direction, but rather represented an acceleration-deceleration phenomenon with a surrling pattern superimposed. Despite this apparent complexity, the time-average character of the flow was consistent and repeatable, and the thermosiphon did not stall, nor did the set point conditions on the flow loop drift significantly during operation. The operating temperature range studied, over which stable thermosiphon operating was noted, would correspond generally to the high temperature stages of a multistage flash evaporator. (Zielinski-MAXIMA)
W82-05916

CONDENSATION OF BUTANE VAPOR IN A GRAVITY-DRAINED ICE BED,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. L. Von Berg, P. Harriott, H. F. Wiegandt, and D. B. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243411, Price codes: A05 in paper copy, A01 in microfiche. Report, August 1974. 83 p, 23 Fig, 6 Tab, 19 Ref, 2 Append. OSW (3072)(1).

Descriptors: *Desalination, *Desalination apparatus, *Ice-brine systems, *Heat transfer, Saline water, Seawater, Brine disposal, Brines, Free water, Ice-water interfaces, Melting, Ice thickness, Process control, Mechanical engineering, Water treatment, Theoretical analysis, *Condensation.

Direct condensation of n-butane in ice particle beds was investigated to assess the effect of driving force, bed depth, and ice particle size on operation of a melter-condenser (MC) as part of an overall freezing process for salt water desalination. Ice melting rate for 2-12 inch thick ice particle beds was studied in a 3 foot by 2 or 4 inch inside diameter plastic column, using 0.1-17 mm diameter ice particles. Studies with the MC indicated that: ice melting rate in shallow ice beds is proportional to the true driving force for driving forces up to at least 0.5 F; ice melting rate per ice volume in the MC decreases with increased bed depth and is a function of ice particle size; and that the rate due to axial vapor velocity through the bed is proportional to the vapor velocity to the 1/4 power. The most severe restriction on melting rate of deep ice beds is imposed by liquid and vapor flow limitations through the melting bed. Butane condensation in shallow beds occurs throughout the entire bed, but the topmost ice particles melt faster than those deeper in the bed. Experimentally-determined heat transfer coefficients (for total particle area at 10% melt) for 3 and 12 inch ice beds were about 2/3 and 1/3 of those predicted from theory. (Zielinski-MAXIMA)
W82-05917

OPERATING EXPERIENCES ON A REVERSE OSMOSIS PLANT WHICH CONVERTS SEA WATER INTO BOILER FEED WATER,
R. M. Quinn.
Industrial Water Engineering, Vol 19, No 1, p 20-33, January/February, 1982. 2 Tab.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Economic aspects, Water treatment, Sea water, Brackish water, Water quality, Membranes, Industrial water, *Boiler water.

Points of interest in the operation and design of the Planta Centro seawater plant installation are offered. The pretreatment system was designed to meet the variable conditions found in using an open sea intake and, in particular, an intake located in a channel, making it subject to the effects of land based contamination. One of the major concerns was the ability of the B-10 membrane in the reverse osmosis system to stand up to the rigorous conditions of seawater treatment. While operating costs appear high compared to conventional water treatment plants, they are comparable to those experienced in treatment of seawater by evaporation. Total power consumption in the primary and secondary system is quite low, due to the relatively low cost of power in Venezuela. Chemical costs are greater than had been anicipated due to the high cost of chemicals in Venezuela, an open sea intake requiring the use of in line coagulation, and the high frequency of cleanup required to maintain the membrane's operation, which overcomes problems with corrosion in the pumps. This final cause of high costs should be eliminated in the future. Overall this plant confirms that in actual operation seawater reverse osmosis systems are viable and effective tools for the production of potable water. Reverse osmosis systems when combined with brackish membranes and conventional ion exchange can produce any level of quality water required by industry, all the way from potable to the ultimate water required by highly sophisticated electronics plants. (Baker-FRC)
W82-05976

WORK POTENTIAL: AN OBJECTIVE BASIS FOR THE COMPARISON OF DESALINATION PROCESSES,
A. N. Rogers.
Industrial Water Engineering, Vol 19, No 1, p 10, 12-19, January/Februrary, 1982. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Desalination, *Energy, Energy loss, Energy equation, Water quality, Water reuse, Water treatment, Brackish water, Seawater.

This paper introduces factors which permit the energy consumptions of various desalination processes to be reduced to a common basis. It is demonstrated that under some conditions thermal distillation processes compare favorably with membrane and freezing processes and with vapor compression distillation from the standpoint of energy consumption. In such a comparison it is essential to consider not only the amount of energy consumed but also the thermodynamic level of the energy. Energy requirements are calculated as Work Potential, that is the electrical energy which the prime heat or power source could generate in a power plant and deliver to a power grid. These calculations indicate that for the desalination of sea water or other concentrated feeds, the thermal evaporative processes of multi-stage flash, vertical tube evaporator, or HTME compare favorably with other desalination techniques. For the desalination of water of low salinity such as brackish water or dilute aqueous wastes streams, thermal desalination requires a slightly greater Work Potential. When supplied with waste heat, however, the Work Potential requirments of thermal distillation are practically identical with those of the membrane processes. (Baker-FRC)
W82-05977

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,
Kyoto Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W82-06006

AN ION-EXCHANGE PROCESS WITH THERMAL REGENERATION XIV THERMALLY REGENERABLE RESIN SYSTEMS WITH HIGH CAPACITIES,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Chemical Technology.
B. A. Bolto, K. H. Eppinger, M. B. Jackson, and R. V. Siudak.
Desalination, Vol 34, No 3, p 171-188, September, 1980. 3 Fig, 14 Tab, 13 Ref.

Descriptors: *Desalination processes, Ion exchange, *Resins, *Polymers, Desalination, Thermal regeneration, *Ion exchange resins, Acrylic acid, Triallyamine hydrochloride, Polymers.

The development of later generations of thermally regenerable (TR) ion-exchange resins is traced from those formed from a solution of the monomers acrylic acid and triallylamine hydrochloride, which gives resins with no TR capacity, to those which have a TR capacity of 2.1 meq/g. The resins include those prepared from a solution or emulsion of monomers, amphoteric resins in which acidic and basic groups are attached to a preformed polymer by a chemical reaction, resins made by polymerizing a monomer (or monomer + crosslinker) inside a crosslinked resin, resins prepared by the graft polymerization of monomers onto polymers on which radicals have been generated and resins prepared by the polymerization of monomers around polymeric microparticles. (Balaban-Boston)
W82-06101

SCALE INHIBITION OF CALCIUM SULFATE BY A FLUIDIZED BED,
Technische Hogeschool, Delft (Netherlands).
J. A. M. Meijer, and G. M. Van Rosmalen.
Desalination, Vol 34, No 3, p 217-232, September, 1980. 7 Fig, 27 Ref.

Descriptors: Desalination, Desalination processes, *Desalination apparatus, *Flash distillation, Fluidized bed evaporator, *Heat exchanger tube, *Scale inhibition, *Calcium sulfate, Scanning electron microscopy.

In a heat exchanger tube of the MSF-FBE the scale inhibiting capacity of the fluidized bed with respect to calcium sulfate was investigated. In all experiments at concentration factors between 1 and 2, the hemihydrate solubility line could be passed to a certain extent within scale formation. The ultimately formed scale consisted of anhydrite except at the largest super-saturation for hemihydrate, where hemihydrate was formed. The highest top temperatures were reached when the brine was deaerated and nuclei were excluded. Scale deposition is prevented better by 2 mm glass particles than by 1 mm glass particles. The very first scale layer at the metal surface shows a very poor crystal habit. (Balaban-Boston)
W82-06104

HYDRODYNAMICS OF CONDENSATE FILMS ON FLUTED TUBE SURFACES. PART I,
Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
Desalination, Vol 34, No 3, p 233-247, September, 1980. 1 Tab, 10 Fig, 8 Ref.

Descriptors: Desalination, Hydrodynamics, *Desalination processes, *Liquid films, *Fluted tubes, *Navier-Stokes equation, *Heat transfer coefficients.

Hydrodynamic characteristics of liquid films in downward motion on the outer surface of fluted tubes have been investigated, both experimentally and theoretically. The solution of the Navier-Stokes equation is aimed at expressing velocity distribution, volumetric flow-rate, friction and cross-sectional area as a function of flute geometry and operating conditions. A general practical relationship has also been derived for the liquid carrying capacity of different flutes. The results provide sufficient information pertaining to the thickness of the condensate film and its variation, thus enabling the prediction of heat transfer coefficients in desalination. (Balaban-Boston)
W82-06105

EFFECT OF SURFACE CONFIGURATION ON HEAT TRANSFER BY THE CONDENSATION OF STEAM OVER FLUTED SURFACES. PART II,
Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
In: Desalination, Vol 34, No 3, p 249-265, September, 1980. 3 Tab, 9 Fig, 10 Ref.

Descriptors: Desalination, *Desalination apparatus, Hydrodynamics, Pilot plants, *Heat transfer, *Film coefficients, *Fluted tubes, Condensation.

Heat transfer characteristics of fluted tubes have been determined by a pilot-plant study. Film coefficients (inside, outside and overall) have been expressed as a function of average liquid velocity. The performance of fluted tubes has been evaluated with respect to flute geometry and operating conditions by considering the hydrodynamic state of the condensate film. A 'geometric criterion' has been formulated to compare fluted tubes of different geometric designs with respect to their performance in heat transfer. (Balaban-Boston)
W82-06106

TRANSFER CHARACTERISTICS OF CONVEX AND CONCAVE RIVULET FLOW ON INCLINED SURFACES WITH STRAIGHT-EDGED GROOVES,
Technion - Israel Inst. of Tech., Haifa.
R. Semiat, D. Moalem-Maron, and S. Sideman.
In: Desalination, Vol 34, No 3, p 267-287, September, 1980. 13 Fig, 25 Ref.

Descriptors: Desalination, *Desalination apparatus, *Heat transfer coefficients, Convex-Concave rivulet flow.

The flow and temperature fields are solved for convex rivulet flow on the crest of a straight-edged groove and for concave rivulet flow in the bottom of the groove. The effect of the plane inclination in the range of $0 < \text{alpha} < \text{pi}$ is accounted for. The general solution converges to the case of flow on a vertical wall where $\text{alpha} = \text{pi}/2$. Solutions for the heat transfer coefficients are presented for boundary conditions of constant flux, constant temperature or constant resistance at the wall. The results are presented for aluminium-water system at 70 deg C with a constant contact angle of 37.7 deg. (Balaban-Boston)
W82-06107

ENHANCED HEAT TRANSFER IN HORIZONTAL EVAPORATOR-CONDENSERS WITH STRAIGHT-EDGED GROOVED TUBES,
Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Chemical Engineering.
D. Moalem-Maron, R. Semiat, and S. Sideman.
Desalination, Vol 34, No 3, p 289-309, September, 1980. 13 Fig, 21 Ref.

Descriptors: Desalination, Desalination processes, Distillation, *Desalination apparatus, *Heat transfer, *Evaporator-condensers(Horizontal).

The flow characteristics on a grooved surface depend on the external feeding rate and the overflow from the crest to the valley between the crests. Energetic considerations affecting transition from convex to concave rivulets are presented. The limiting bounds for minimum and maximum flow with full wetting of the groove determine the desired range of practical operation with different groove dimensions. The corresponding average groove-side heat transfer coefficients are presented. Overall heat transfer coefficients for the simultaneous evaporation-condensation process were calculated for various operating conditions and different grooved surfaces. Comparison with experimental data is satisfactory, but nevertheless indicates lack of availability of reliable data for the dynamic solid-liquid contact angle. (Balaban-Boston)
W82-06108

STUDIES ON SYNETHESES AND PERMEABILITIES OF SPECIAL POLYMER MEMBRANES.28. PERMEATION CHARACTERISTICS AND STRUCTURE OF INTERPOLYMER MEMBRANES FROM POLY(VINYLIDENE FLUORIDE) AND POLY(STYRENE SULFONIC ACID),
Kansai Univ., Osaka (Japan). Dept. of Chemistry.
T. Uragami, M. Fujimoto, and M. Sugihara.
Desalination, Vol 34, No 3, p 311-323, September, 1980. 2 Tab, 6 Fig, 15 Ref.

Descriptors: Desalination, *Membranes, *Membrane processes, *Polymer membranes, Poly(vinylidene fluoride), Poly(styrene sulfonic acid).

The permeation characteristics of poly(vinylidene fluoride) -poly(styrene sulfonic acid) interpolymer membranes in the separation of polymers, poly(ethylene glycols), from their aqueous solutions were investigated under various conditions. The permeation characteristics were influenced markedly by the casting solution composition and operating temperature. It was seen by scanning electron photomicrographs that the changes of ratio of poly (vinyliden fluoride)-poly(styrene sulfonic acid) were related to the changes of microporous structure of the resulting membranes. The permeation rates for aqueous solutions of poly(ethylene glycols) were greater than for pure water. It was found that this phenomenon was dependent on the physical and chemical natures of the membranes and the permeating molecules. The permeation mechanism through the interpolymer membranes was not only the viscous flow. (Balaban-Boston)
W82-06109

RO, MSF AND VTE/VC DESALINATION: A COMPARATIVE EVALUATION,
Envirogenics Systems Co., El Monte, CA.
I. Kamal, D. K. Emmermann, and G. F. Tusel.
Desalination, Vol 33, No 3, p 229-240, June, 1980. 5 Fig, 3 Tab, 3 Ref.

Descriptors: Desalination plants, *Desalination processes, *Reverse osmosis, Cost comparisons, *Multistage flash distillation, *Evaporators.

For seawater conversion in single-purpose plants, reverse osmosis is shown to be more economical than multistage flash desalinatiion over a wide range of unit size and fuel cost. Attention is focussed on vertical tube evaporation/vapor compression, a self-contained, low-energy consuming thermal process which is potentially competitive with RO. (Balaban-Boston)
W82-06110

MAGNESIUM OXIDE PRODUCTION FROM CONCENTRATED BRINES,
L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, V. Brandani, G. Di Giacomo, and P. U. Foscolo.
Desalination, Vol 33, No 3, p 241-250, June, 1980. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Desalination wastes, Desalination plants, *Brine wastes, *Magnesium oxide, Calcium sulfate, Capital costs, Operating costs.

Magnesium oxide production from concentrated brines wasted in sea water desalting plants has been investigated. Unlike traditional Mg recovery plants from sea water, it is necessary to undertake purification of the precipitated magnesium hydroxide by means of a carbonation-decarbonation section in order to remove calcium sulphate impurities. Such an operation gives flexibility to the whole plant and allows a high purity product to be obtained. This note illustrates all the stages of the proposed process together with the relevant operating conditions. In comparison with the traditional Mg recovery plants from sea water, it has also been found that the capital and operating costs related to the carbonation-decarbonation section are substantially balanced by the elimination of the sea water intake and of the feed pretreatments, as well as by the reduction of the flow rates to be handled in the first plant section. (Balaban-Boston)
W82-06111

HEAT TRANSFER IN A ROTATING DISK EVAPORATOR,
California Univ., Berkeley. Sea Water Conversion Lab.
C. S. Wang, R. Greif, and A. D. K. Laird.
Desalination, Vol 33, No 3, p 259-268, June, 1980. 8 Fig, 9 Ref.

Descriptors: Desalination, *Desalination equipment, *Heat transfer, *Evaporators, Rotating disk evaporator, Copper, Monel.

Experiments were carried out in a rotating disk evaporator with and without a wiper on the evaporation side. The tests were carried out with copper and with monel disks. Overall heat transfer coefficients were obtained directly from the measurements. In addition, evaporation heat transfer coefficients were calculated and the results were correlated. The effectiveness of the wiped film evaporator was clearly manifested in the larger heat transfer coefficients that were obtained. (Balaban-Boston)
W82-06112

SOME BASIC OBSERVATIONS ON HEAT TRANSFER AND EVAPORATION IN THE HORIZONTAL FLASH EVAPORATOR,
Pennsylvania Univ., Philadelphia.
N. Lior, and R. Greif.
Desalination, Vol 33, No 33, p 269-286, June, 1980. 10 Fig, 1 Tab, 24 Ref.

Descriptors: Desalination, *Distillation, Horizontal flash evaporator, *Heat transfer, *Evaporators.

This paper describes a study of the heat, mass and momentum transport associated with vapor release in a horizontal stage of a flash evaporator. A scaled-down, well-controlled flash evaporator, which also allows good visual observation, has been designed constructed and used in the experiments. In paticular, temperature profiles in the stage have been measured to an accuracy of + 0.02 deg C and better. It has been determined that the subcritical flow in the flash stage consists of two principal regions: submerged sluice gate flow with the associated hydraulic pump overlayed by a backflow roller, followed by open channel flow. The flashing of NaC1 solutions was accompanied by strong foaming, which has reduced the fractional non-equilibrium allowance by a factor of two or three, without impairing the purity of the distillate. (Balaban-Boston)
W82-06113

MYTHS ABOUT FREEZE DESALTING,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
H. F. Wieandt, and R. L. Von Berg.
Desalination, Vol 33, No 3, p 287-298, June, 1980. 4 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, *Desalination processes, Freezing, *Freeze desalting.

Since the inception of freezing as a process for desalting sea water, a variety of misconsceptions about the process have evolved and persisted, even when countered with scientific and engineering information to the contrary. Such misconceptions or myths have been very damaging to the commercial development of freezing as a competitive desalination process. A number of these myths are explored with respect to their engineering validity and a comparison is made between freezing and other important desalination processes. (Balaban-Boston)
W82-06114

FREEZING PROCESSES - THE STANDARD OF THE FUTURE - AN UPDATE,
Schroeder Process Corp., Santa Ana, CA.
P. J. Schroeder.
Desalination, Vol 33, No 3, p 299-310, June, 1980. 3 Fig, 6 Ref.

Descriptors: *Desalination plants, Desalination processes, Freezing, *Freeze desalting.

A previous work took the position that freezing processes would be the standard of the future, at least in cases where the feedwater has the concentration of sea-water or higher. It then summarized Fluor's ongoing work on a 10,000 gpd eutectic freezing pilot plant and a freeze desalting plant using the 'cold' from an LNG plant. This work focuses primarily on the progress in coupling a freeze desalting plant to an LGC vaporizer. (Balaban-Boston)
W82-06115

A COMPREHENSIVE FORMAL APPROACH TO THE EVALUATION OF BIDS FOR DESALINATION PLANTS USING VERBAL JUDGEMENT,
Science Applications, Inc., Ames, IA.
R. Kenarangui, A. Husseiny, and Z. Sabri.
Desalination, Vol 33, No 3, p 311-331, June 1980. 10 Fig, 6 Tab, 5 Ref.

Descriptors: Desalination, *Desalination plants, Economics, Social aspects, Safety, Environmental consideration, Political aspects, *Cost analysis.

Evaluation of competitive bids for large engineering projects such as desalination plant construction requires careful consideration of several factors other than pure economic merits; namely, technical characteristics of bids, the socio-political situation, safety merits, environmental aspects, public acceptance and other non-financial aspects. A method is developed here based on verbal judgement and fuzzy set theory to allow for comprehensive and systematic formal evaluation of bids. The method is applied to a case study and can be directly used by the technical team to make the final conclusion. The method is implemented in the form of a computer code (MAFDA) which is suitable for interactive computer facilities. (Balaban-Boston)
W82-06116

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,
Ben-Gurion Univ. of the Negev, Beersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 2, p 123-138, May, 1980. 5 Fig, 6 Tab, 15 Ref.

Descriptors: *Recycling, Waste recovery, *Ion exchange, Desalination, Wastewater treatment, Operating costs.

Recycling of waste water by ion-exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime fluocculation, served as a feed for the ion-exchange system. It was found that both the salt concentration and the organic matter content of the effluent could be reduced to produce high quqlity water, suitable foor a wide range of agricultural and industrial applications. Salt concentrations was reduced from 15 meq/1 (750 ppm as CaCO3) to about 1 meq/1 (50 ppm as CaCO3) and the organic matter, from 70-100 mg/1 COD (chemical oxygen demand) to 20 mg/1. The anion exchanger was regenerated with Ca(OH)2 according to a new method recently developed. The treatment cost for a 2000 m(3)/day plant was calculated to be 18.0 cents/cu m. (Balaban-Boston)
W82-06118

MASS TRANSFER IN THE U-TURN OF AN ELECTRODIALYZER,
Korea Advanced Inst. of Science, Seoul. Dept. of Chemical Engineering.
I. H. Kim, I. S. Kang, and H. N. Chang.
Desalination, Vol 33, No 2, p 139-161, May, 1980. 12 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, Desalination processes, *Electrodialysis, Hydrodynamics, *Mass transfer, Spacers.

As a link in the chain of the hydrodynamic theories on electrodialysis, the mass transfer rate in the U-turn of a tortuous spacer was investigated. Besides, the solutions by Sonin and Probstein (1968) for a straight channel geometry were modified using a concentration profile approximated with a third order polynomial. The flow in a U-turn geometry at low Reynolds numbers was analyzed with the aid of the potential flow theory, and the related mass transfer problem was solved in connection with the flow field solution for the U-turn and the revised concentration distribution. Theoretical analysis showed that the desalting efficiency in the U-turn was nearly the same as that in the straight channel for low polarization but the efficiency was lower for high polarization. Experimental results for the U-turn geometry were in good agreement with the theory for the case of low polarization. However the discrepancy between the two was noticeable for the case of high polarization. Also the disagreement became more pronounced at higher flow velocities possibly owing to the formation of a secondary flow caused by centrifugal forces. (Balaban-Boston)
W82-06119

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,
Mobil Oil A.G., Celle (Germany, F.R.).
G. Wilken.
Desalination, Vol 33, No 2, p 21-210, May, 1980. 4 Fig, 18 Ref.

Descriptors: Water purification, *Scale formation, Additives, Crystal growth inhibitors, *Scaling, *Calcium carbonate prevention.

Additives which act non-stoichiometrically during the threshold treatment process are of interest for the control of water formed deposits in water purification or circulation systems. The relevant literature describes the mechanism of the process to prevent precipitation of calcium carbonate. Scale deposition can be reached by adding certain compounds, which are generally polymers or polyelectrolytes, to the solution. Such additives act as crystal growth inhibitors by being adsorbed onto the growing faces of submicroscopic crystals or crystallites. At low supersaturation this gives a stable colloid which can be carried out of the reaction zone by the fluid. In the particular case of a highly supersaturated solution the common additives are not sufficiently effective in preventing scale deposition. The purpose of this paper is to develop a water treatment based on the crystal growth distortion by the scale-inhibitors to produce aggregates which are removable by gas or liquid. The present investigation examines the ability of commercially available scale-inhibitors, stable in aqueous solutions above 100 degree C, to prevent regular calcium carbonate crystal growth. The effectiveness of scale-inhibitors is predominantly concerned with alterations in crystal habit and in characteristics of the precipitate morphology. (Balaban-Boston)
W82-06120

CRITICAL ANALYSIS OF A PROPOSED SOLAR ASSISTED HTE DESALINATION SYSTEM,
Sidney Univ. (Australia).
G. G. Fenton, and J. P. Gerofi.
Desalination, Vol 33, No 2, p 211-220, May, 1980. 6 Fig, 6 Ref.

Descriptors: Desalination, Desalination processes, *Solar assisted desalination, Cost analysis.

A solar assisted desalination system proposed by Gasparini et al. is reviewed. The authors show that there are errors and misconceptions in the paper that render its conclusion invalid. Factors that should be considered in a rigorous analysis of the problem are outlined. Contrary to the original conclusions the current analysis shows that a flat plate collector system is a more attractive proposition than a concentrating option, and that the actual payback periods for the options proposed are unacceptably long at present fuel oil prices. (Balaban-Boston)
W82-06121

ANALYSIS OF LARGE DESALINATION PLANTS,
L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, D. Bogazzi, A. Germana', and G. Tagliaferri.
Desalination, Vol 33, No 1, p 1-10, April, 1980. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Desalination, *Desalination plants, *Desalination processes, Distillation, *Multi-flash distillation, Construction, Operation, Reliability, Economics, Unit size.

The experience achieved in the construction and operation since 1973 of the larges MSF desalination unit in the world (8 migd) is the basis for a detailed analysis aimed at contributing to the determination of the practical top size of such units. Taken into account are the reliability and engineering problems as well as economic aspects deriving from the multi-stage flash (MSF) unit size. The problem assumes particular interest when related to the actual trend to limit the maximum unit size normally to 5 migd and in a few cases 6 migd so that consequently some water stations have a large number of parallel units. (Balaban-Boston)
W82-06122

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5D.
W82-06123

MSF DESALINATION PLANTS, AVAILABILITY, RELIABILITY AND SAFETY ANALYSIS,
Science Applications, Inc., Palo Alto, CA.
A. Unione, E. Burns, and A. A. Husseiny.
Desalination, Vol 33, No 1, p 49-84, April, 1980. 14 Fig, 6 Tab, 51 Ref.

Descriptors: Desalination, *Desalination plants, *Performance evaluation, *Multistage flash distillation, Seawater, Availability, Reliability, Safety analysis.

While good MSF desalination plant performance exerts a positive influence on plant economics, as part of water supply systems in isolated regions, the availability of the desalination system becomes a major design criterion. Reliability problems have historically been a major cause of poor performance for desalination plants. The emphasis of this paper is on the importance of availability modeling methodology to MSF desalination plant reliability problems by providing a context in which the effect of unit unavailability can be quantified. An assessment is made of failures and outages which impact the availability of MSF desalination plants. Limited fault tree logic for system failures is developed and reliability data from the literature is incorporated, where possible. The impact of other water supply system failures on the reliability requirements of the desalination plant is quantified as are the effects of increased average water system demands. The single largest influence on the effective capacity of a water supply system based on MSF desalination of sea water is found to be the availability and maintainability of the desalination plant. Forced outages as a result of equipment failure are significant, but other dominant contributions to unit unavailability include externally caused problems, such as silting. The design configuration of the desalination plant is also found to have an impact on the acceptability of water supply system performance. (Balaban-Boston)
W82-06124

ABSORPTION FREEZING VAPOR COMPRESSION - PROCESS SELECTION, PILOT PLANT DESIGN, PROCESS ECONOMICS,
Concentration Specialists, Inc., Andover, MA.
James H. Fraser.
Desalination, Vol 33, No 1, p 85-98, April, 1980. 4 Fig, 7 Tab.

Descriptors: *Desalination plants, Desalination processes, *Freezing, *Vapor compression, Economics, Pilot plants, Capital costs, Operating costs.

A 25,000 gpd Absorption Freezing Vapor Compression (AFVC) pilot plant was built. Additional studies were conducted in order to prepare capital and operating cost estimates on 100,000 and 1,000,000 gpd plants. AFVC is a new freezing process for desalination and other concentration/separation applications that uses an absorption cycle powered by a heat pump. Power consumption of 42 and 38 kWh/1000 gal. were calculated for the 100,000 and 1,000,000 gpd plants respectively. The 25,000 gpd pilot plant consists of three major process vessels freezer/absorber, wash column/melter, and generator - and two equipment skids - one for the refrigeration equipment and one for the pumps, air removal equipment and heat exchangers. (Balaban-Boston)
W82-06125

MATERIAL SPECIFICATION AND THE AVAILABILITY AND LIFE OF DESALINATION EQUIPMENT IN BOTH SAUDIA ARABIA AND THE ARABIAN GULF,
Conan/Temperley and Associates, Jeddah (Saudi Arabia).
Tom G. Temperley.
Desalination, Vol 33, No 1, p 99-108, April, 1980.

Descriptors: Desalination, *Desalination equipment, *Specifications, *Evaporators, *Materials engineering, *Saudi Arabia, Arabian Gulf.

The author describes operational experience with various materials of construction in both low temperature polyphosphate treated evaporators and also in high temperature evaporators using acid treatment. The author references the repeated use of unsuitable materials and proposes a solution by the development of more detailed and positive specifications for plant and equipment. A problem faced by many manufacturers is the fact that as a result of broad, open specifications they are forced to use inferior materials in order to remain competitive. The author discusses the use of both corrosion resistant linings and operating experience. In summary, the paper correlates the operating conditions with selection of materials. (Balaban-Boston)
W82-06126

SALBUKH REVERSE OSMOSIS PLANT ON STREAM,
Vattenbyggnadsbyran Ltd., Stockholm (Sweden). Dept. of Water, Soil and Environment Development.
B. Ericsson.
Desalination, Vol 33, No 1, p 109-114, April, 1980. 1 Fig, 3 Tab, 1 Ref.

Descriptors: Desalination, *Desalination plants, *Reverse osmosis, Pretreatment, Performance evaluation, Salbukh.

An inspection test on the RO plant at Salbukh treatment plant was carried out for 96 hours. The RO plant was successfully brought into operation and the requirements on water quality, water production and water losses satisfied. Based on the performance test, VBB recommends that the RO installation be accepted. Raw water cooling in the pretreatment plant is, however, not acceptable at present. The RO feed water temperature was about 38-40 degree C instead of about 35 degree C due to the lower efficiency of the coolers than calculated, a failure to be rectified by the Contractor. During the last few months the pretreatment of raw water from Well 54 at Buwayb has been investigated by Ames Crosta Babcock by means of final operation of a pilot plant. Based on these results, the use of 140 mg/1 lime and 100 mg/1 soda for chemical softening has been recommended by VBB. The high TDS of the raw water in Well 54 indicates that the final blended water at the same water production rate as originally designed, will contain around 750 mg/1 TDS. However, there is now an indication that the average TDS with all the deep wells in operation will be around 650 mg/1 in blended water due to the low average TDS in the raw water. The pretreatment plant at Buwayb was partly brought into operation in October/November, and the pretreated water is discharged into the water disribution net and blended with desalinated water from Salbukh. (Balaban-Boston)
W82-06127

THE DEVELOPMENT OF DRY-RO MEMBRANES FROM CELLULOSIS AND NONCELLULOSIS POLYMERS BEARING QUATERNARY AMMONIUM GROUPS,
Puropore, Inc., Tustin, CA.
R. E. Kesting.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243676, Price codes: A03 in paper copy, A01 in microfiche. Report, June 1981. 43 p, 3 Fig, 20 Tab. OWRT C-00133-S(0463)(1), 14-34-0001-0463.

Descriptors: *Reverse osmosis, *Cellulose acetate membranes, *Membranes, *Ion exchange, *Synthesis, Membrane processes, Chlorination, Wastewater treatment, Membrane filters, Polymers, Physicochemical properties, Structure, Physical properties, Chemical properties, Chemical reactions, Fabrication, Evaluation, Water treatment.

Studies were carried out on reverse osmosis (RO) membranes prepared from both cellulosic and noncellulosic materials. For cellulosic membranes produced from quarternized cellulose triesters (QCTE), a successful resolution was achieved to the problems of their high cost and less than optimum reproducibility for dry RO membranes. Blends of QCTE polymer which contained two and three times the optimum ion-exchange capacity (x) could be blended with one or two parts, respectively, of neutral cellulose acetate to yield blend membranes with equivalent performance to those prepared from a homopolymer QCTE with an ion-exchange capacity of x. For noncellulosic membranes, it was found impractical to introduce quarternary ammonium groups into polysulfone. In attempting to find other suitable noncellulosic polymers, aromatic polyamides (specifically, various piperazine phthalamides) were investigated. It was discovered that piperazine ortho-phthalates were sufficiently soluble in methylene chloride/isopropanol (an excellent dry process solvent system) as to permit fabrication of integrally-skinned wet-dry reversible RO membranes. This class of polyamides are thermally-stable and chlorine-resistant, and may lead to a universally applicable RO membrane. (Zielinski-MAXIMA)
W82-06152

ORIENTED MONOLAYER ASSEMBLIES TO MODIFY FOULING PROPENSITIES OF MEMBRANES.
Southern Research Inst., Birmingham, AL.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254913, Price codes: A06 in paper copy, A01 in microfiche. Report SORI-EAS-81-635, July 1981. 108 p, 52 Fig, 7 Tab, 50 Ref, 1 Append. OWRT C-000-99-S(0440)(1), 14-34-0001-0440.

Descriptors: *Membrane processes, *Anion exchange, *Membranes, *Monomolecular films, *Fouling, Ion exchange, Synthesis, Thin films, Polarization, Microscopic analysis, Humic acid, Biodegradation, *Desalination processes, Desalination apparatus, Demineralization, Saline water.

Research was conducted to test whether oriented monomolecular-layer assemblies bearing positive charges would mitigate the fouling propensities of anion-exchange membranes, especially if the oriented layers were fluorinated. Fouling tests with membranes coated by oppositely and similarly charged multilayers should also demonstrate the relative importance of several membrane surface characteristics earlier shown to play roles in initiation of autocatalytic concentration polarization and fouling. Membrane surfaces were modified by coating with individually-oriented layers of amphiphilic modules (having polar and non-polar ends), using the classical Blodgett dipping technique. It was determined that, with appropriate selection of amphiphilic compounds and packing densities, it was possible to independently vary hydrophilicity, homogeneity, and rugosity, thereby establishing the relative importance of these factors in the fouling process. Even a single deposited oriented monolayer of 20 A thickness strikingly modified the microscopic appearance and the electrical and fouling behaviors of anion-exchange membranes. (Zielinski-MAXIMA)
W82-06167

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. C. Stitt, C. A. Loeser, J. M. Hodgson, and G. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234162, Price codes: A10 in paper copy, A01 in microfiche. Report REC-ERC-81-14, May 1981. 217 p, 32 Fig, 2 Tab, 4 Ref, 7 Append.

Descriptors: *Monitoring, *Desalination plants, *Plugging factor, *Water treatment, Particulate matter, Colorado River, Drainage water, Computers, Salinity.

The Yuma Desalting Test Facility was constructed to provide data needed for the design of the proposed Yuma Desalting Plant, near Yuma, Arizona. This plant would provide drainage water treatment for the Wellton-Mohawk Irrigation and Drainage District. The plant would subsequently reduce the salinity of Colorado River water delivered to Mexico. The instrumentation requirements for the test facility include monitoring the plugging factor of the water at various points in the water pretreatement process. The measurement of this factor is used to indicate the amount of organic and inorganic particulate matter which is suspended in the water. To automate the measurement process, a controller was needed for the measuring device. The function of the Plugging Factor Monitor Electronic Controller is to provide plugging factor measurements on any or all of the six possible sample streams. The Plugging Factor monitor can be incorporated into any water treatment facility where the measurement of a plugging factor is required. (Moore-SRC)
W82-06398

APPARATUS FOR DESALINATING WATER,
R. E. Diggs.
U.S. Patent No 4,203,806, 18 p, 21 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 975-976, May 20, 1980.

Descriptors: *Patents, *Water treatment, Water purification, *Desalination processes, Desalination apparatus, Solar radiation, Desalination wastes, Distillation, Vapor compression distillation, Solar distillation.

Contaminated water flows across a grid and into a storage tank. The grid utilizes solar energy to heat that water to a predetermined temparature. A heat transfer structure which is dome-shaped and receives water from the storage tank and a preheater utilizing solar energy heats the water to a further predetermined temperature. An evaporator receives the heated water and exposes it to a vacuum condition so that the temperature of the water is above the saturation temperature. The water is thus vaporized, and solid contaminants dissolved. The solids are deposited on moving belts and are then moved into a solids removal system comprising trap door pairs upon which the solids are deposited and which are sequentially opened so that the vacuum conditions existing in the evaporator are not disturbed. Vapor transferring means remove the water vapor from the evaporator and transfers it to the heat transfer structure where it is condensed to form distillate which is free of contamination. The distillate is removed to a collection tank. (Sinha - OEIS)
W82-06711

MOLECULAR (OSMOTIC AND ELECTRO-OSMOTIC) BACKWASH OF CELLULOSE ACETATE HYPERFILTRATION MEMBRANES,
California Univ. Berkeley. Sea Water Conversion Lab.
K. S. Spiegler, and J. H. Macleish.
Journal of Membrane Science, Vol 8, No 2, p 173-192, March, 1981. 9 Fig, 24 Ref.

Descriptors: *Backwash, *Desalination apparatus, *Hyperfiltration, Membrane processes, *Cellulose acetate, membranes, *Osmosis, *Electro-osmosis, *Molecular backwash, Salt rejection, Filtration, Saline water.

A molecular backwash technique, developed to clean and rejuvenate contaminated asymmetric cellulose acetate membranes used in desalting plants, was based on osmosis and/or electro-osmosis. When the membranes were contaminated with ferric hydroxide, they showed substantial resistance to mass transfer and considerable flux decrease. Four types of backwashing experiments were performed: (1) osmotic backwash with no flushing, (2) osmotic backwash with flushing with deonized water, (3) and (4) electro-osmotic backwashing with and without flushing, applying as electric current (typical current density,-32mA per sq cm) to the membrane for 20-30 min. In all cases the hyperfiltration pressure was lowered to 5-30 psi during backwashing and raised to 6000 psi to continue filtration. After molecular backwashing, flux loss recoveries were 30-100%. In some cases the salt rejection loss which had occurred during contamination was partially restored. Electro-osmotic backwash was more beneficial than osmotic backwash. (Cassar-FRC)
W82-06792

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,
Scientific Research Inst. of Plastics, (USSR).
For primary bibliographic entry see Field 5D.
W82-06988

3B. Water Yield Improvement

CHINA'S AGRO-ECOSYSTEM,
Manitoba Univ., Winnipeg. Dept. of Geography.
V. Smil.
Agro-Ecosystems, Vol 7, No 1, p 27-46, 1981. 2 Fig, 4 Tab, 45 Ref.

Descriptors: *Agriculture, *Irrigation, Water resources development, *Environmental effects, Land management, *China, Soil erosion, Water pollution, Aquaculture, Drainage, Water transfer, Pumping, Water management.

Regional lack of moisture is a critical environmental constraint to China's agro-ecosystem. The climate ranges from subtropical in the southeast to arid in the north and northwest. Mean annual precipitation varies from 577 mm to 1720 mm. In some areas evaporation exceeds precipitation by up to 4 times. Water resources development and control have been an integral part of China's agriculture for centuries. As of 1979 the irrigation system included 80,000 reservoirs, 5000 canal networks, and 2 million power operated wells. Several large multipurpose water projects are under construction. Aquaculture has deteriorated in recent years because of pollution, dam building, and land reclamation. The capacity of agricultural pumps for drainage and irrigation was 47 GW in 1978, a large increase from 0.13 GW in 1950. China's agricultural system faces many problems. The mechanical irrigation systems are not efficient. Leaks and seepage losses are 50-60%, power shortages idle the pumps for long periods, and sprinkler irrigation is in an early stage of development. Soil erosion is a wide-spread and serious environmental problem, caused by land mismanagement. A proposed water transfer from the Yangzi basin to the chronically dry north also poses environmental hazards. (Cassar-FRC)
W82-06019

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
D. S. Mull, S. Cordiviola, and D. W. Risser.
Geological Survey Open-File Report 81-690 (WRI), 1981. 51, p 14 Fig, 2 Plates, 12 Tab, 35 Ref.

Descriptors: *Groundwater, *Available water, *Water quality, *Coal mines, Mine drainage, Recharge, Precipitation, Streams, Water demand, Water analysis, Chemical analysis, Potential water supply, *Kentucky, Johnson County, Martin County.

The location and mine volume is shown for all abandoned coal mines that contained water in Johnson and Martin Counties, Ky. The principal factors that affect the occurrence of water in coal mines is mine size, intensity and duration of precipitation and the location of the mine relative to the nearest perennial stream. Water usually flows from mines that were developed above drainage whereas water usually must be pumped from flooded galleries of mines below drainage. Ten above-drainage mines discharged from 12 to 1,700 gallons of water per minute. Sustained discharge from the largest above-drainage mine ranged from 750 to 1,200 gallons per minute. Eight below drainage mines are considered potential sources of water. Test pumping and hydrographs indicate the seasonal recharge rate into below drainage mines varies from 660 to 103,500 gallons per day. Estimates of water stored in individual mines ranged from 22 to 1,462 million gallons. This water could sustain a supply through periods of limited recharge to the mine. Most mine water is a calcium magnesium sulfate type. Hardness ranged from soft to very hard and pH ranged from 3.1 to 8.0 units. The concentration of most dissolved constituents was lower in water from below-drainage mines than in water from those above-drainage. (USGS)
W82-06136

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,
Illinois State Water Survey, Champaign.
For primary bibliographic entry see Field 6B.
W82-06176

CAVE WATER--JAVA'S HIDDEN RESOURCE,
A. Bingham.
World Water, Vol 5, No 5, p 49-51, May, 1982. 1 Fig.

Descriptors: *Water supply, *Developing countries, *Caves, Wells, Groundwater availability, Aquifers, Exploitation, Sinkholes, Underground streams, Java, *Indonesia.

In the dry summer season villagers in the Yogyakarta region of Indonesia must walk up to 15 km to obtain drinking water from clay floor sinkholes and caves in the fissured limestone hills. The presence of water in these places has prompted renovation of the sinkholes by sinking shaft wells. This water supply, filtered by the clay, is cleaner and more reliable than surface pools. Most cave water is obtained from shallow dirty pools near the entrances. However, underground streams and large pools have been discovered in some caves. It is believed that these less accessible, but more abundant, supplies may be tapped by sinking well shafts, removing rock, or installing pumps. (Cassar-FRC)
W82-06605

3C. Use Of Water Of Impaired Quality

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
M. W. Nabors.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243445, Price codes: A07 in paper copy, A01 in microfiche. Report No 109, October 1981. 133 p, 16 Ref, 7 Append. OWRT B-208-COLO(1), 14-34-0001-0211.

Descriptors: *Culturing techniques, *Water stress, *Salt tolerance, *Water use efficiency, Plant pathology, Stress, Median tolerance limit, Plant growth, Crop production, Crop yield, Water use, Tobacco, Oats, Wheat, Coastal plains, Coastal waters, Arid climates.

Research has been carried out which demonstrates the usefulness of tissue culture to assess stress tolerance in plants. This technological approach is shown to be a useful vehicle for the assessment of

agriculturally-useful plants that exhibit tolerance to low irrigation water supplies or salt water for enhancing food production in arid or coastal areas. The available methodology was improved and new methodology established. Available tissue culture methodology can be used to rapidly select NaCl-tolerant cell lines and to regenerate whole plants from those lines in tobacco, oats, and wheat. In tobacco, regenerated plants are salt-tolerant, pass this tolerance on to two generations of offspring, and give rise to tolerant callus when returned to tissue culture. Regenerated oat plants require a short period of exposure at 30 degrees to become established in pot culture, and exposure to about 20 degrees during the rest of the life cycle to set seed. In addition, initial studies on the mechanism of salt tolerance in cultured cells and regenerated plants have been completed. Future research should focus on the development and implementation of tissue culture methods to obtain increased efficiency of water utilization for agriculturally-useful plants. (Zielinski-MAXIMA)
W82-05920

WASTEWATER IRRIGATION OF FRUIT TREES,
Tuskegee Inst., AL. Dept. of Agricultural Sciences.
F. M. Basiouny.
BioCycle, Vol 23, No 2, p 51-53, March/April, 1982. 1 Tab, 52 Ref.

Descriptors: *Wastewater irrigation, *Irrigation water, *Fruit crops, Reviews, Orchards, Water reuse, Land application, Accumulation, Saline water, Heavy meals, Metals, Pathogens, Nutrients.

Wastewater irrigation of fruit trees has a two-fold benefit: addition of mineral and organic nutrients and renovation of the wastewater. This practice can save 25-50% in production costs. Most non-industrial wastewaters have salinity levels of 300-700 ppm, within the salinity range suitable for irrigation water. However, foliar spraying should be avoided in orchards. Potential problems in wastewater irrigation are toxicity or plant uptake of heavy metals and transmission of disease organisms. The heavy metal problems can be controlled with careful management. Pathogenic contamination of fruit tree products is very unlikely, since bacteria and viruses can be effectively removed by primary and secondary treatment. (Cassar-FRC)
W82-06008

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,
Riyadh University (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 5E.
W82-06228

EFFLUENT IN TRICKLE IRRIGATION OF COTTON IN ARID ZONES,
Ben-Gurion Univ. of the Negev, Sde-Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, J. Ben-Asher, and Y. DeMalach.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p115-126, June, 1982. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater irrgation, *Irrigation water, *Trickle irrigation, *Cotton, Arid lands, Beer-Sheva Vally, *Israel, Nutrients, Fertilizers, Crop yield.

Treated wastewater from facultative oxidation ponda was aplies to cotton on loess soil by tickle irrigation in the arid Beer-Sheva Valley, Israel, during 1980. Six trickle irrigation treatments and a sprinkler irrigation treatment were applied. Irritation itervals were 2,3,7, and 12 days; emitter discharges were 2,4, and 8 liters per hour; emitter spacing between rows, 1.92 and 2,88 m; and mitter spacing on laterals, 1.0. m. Cumulative water application was about 600 mm for the season in all treatments. The highest cotton yield, 604.1 kg per 1000 sq m, was produced by the smallest emitter discharge, smaller eitter spacing, and 2-day irrgation interval. The lowest yield, 375.6 kg per 1000 sq m, was produced by the largest emitter discharge, larger emitter spacing, and 12 day irrigation interval. No additional fertilizers were applies in any treatments. Proper screen filtration eliminated emitter clogging. (Cassar-FRC)
W82-06333

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5G.
W82-06400

EXPANDING OPTIONS FOR GREYWATER TREATMENT,
Lombardo and Associates, Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06491

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,
CH2M/Hill, Redding, CA.
S. C. Ebe, and S. M. Stroud.
Public Works, Vol 113, No 3, p 68-69, March, 1982.

Descriptors: *Food-processing wastes, *Impaired water use, *Land application, Wastewater treatment, Merced, California, Land disposal, Wastewater irrigation, Irrigation water, Crop land, Monitoring.

High strength food processing wastewaters are applied to city owned crop land in Merced, California, during the canning season, mid-August to mid-October. This procedure relieves the seasonal overload on the municipal wastewater system and allows the discharges to meet state requirements. The 985 acre disposal site, adjacent to the treatment plant, was plowed to a depth of 3.5 ft and gypsum added. Oat hay and wheat grain are grown. The system, which became operational in August 1979, consists of seven 80 acre fields with pump stations and piping. Wastewater can be delivered to any one or any combination of the seven fields via a 14 inch pipe. The flow is channeled through a head ditch to individual border checks. Runoff is returned to the head ditch. In the spring irrigation season secondary municipal effluent may be used as a supplement. The versatile system also allows the food wastewater to enter the municipal treatment plant during periods of low flow in winter and early summer. Drainage control structures were created for flood control. An adjacent 385 acre wetlands area receives secondary treated effluent. The project includes a water quality monitoring program. (Cassar-FRC)
W82-06507

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,
Williamsport Sanitary Authority, PA.
M. H. Gerardi, O. A. DeParasis, and W. H. Falk.
Public Works, Vol 113, No 3, p 59-60, March, 1982. 1 Fig, 2 Tab.

Descriptors: *Water conservation, *Impaired water use, Wastewater treatment, *Treatment plants, Effluents, Williamsport, Pennsylvania.

Two Williamsport, Pennsylvania, wastewater treatment plants reduced water usage by about 60% during a period of drought in early 1981. Average daily consumption for the Central plant was 12,500 gal in 1979-80 and 6,000 gal in 1981; for the West plant, 6,000 gal in 1979-80 and 2,000 gal in 1981. Conservation measures consisted of minimizing use of potable water and maximizing use of secondary effluent. Flow restrictors, new water faucet washers, and three-minute showers saved potable water. Effluent was used to wash equipment, floors, vehicles and treatment tanks, and to launder rags. Other uses of effluent included sprinkling scum on secondary clarifiers, packing glands for the raw sewage pumps, concrete curing, cleaning bar screens, hosing foam, flushing lines, and lubricating sludge pump pistons. (Cassar-FRC)
W82-06512

A COMPARISON OF THE EFFECTS OF SALINITY ON PHOTOSYNTHETIC PHYSIOLOGY OF A SALT SENSITIVE GRASS, PANICUM OBTUSUM, AND A SALT TOLERANT GRASS, DISTICHLIS SPICATA,
New Mexico State Water Resources Research Inst., Las Cruces.
P. R. Kemp, and G. L. Cunningham.
New Mexico Water Resources Research Institute, Report No 143, March 1982. 19 p, 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salinity, *Saline soils, *Saline water, *Salt tolerance, *Grasses, Photosynthesis, Assimilative capacity, Stomata, Growth rates, Growth media, Halophytes, Temperature effects, Plant water potential.

Utilizing salt tolerant crops could potentially increase agricultural productivity in the southwest by using brackish water from vast underground resources or through increased growth on salt-damaged fields. Selecting and breeding salt tolerant crops requires an understanding of the physiological and anatomical mechanisms of salt tolerance. A salt sensitive grass and a salt tolerant grass were the subject of this experiment on the effects of substrate salinity. There were three experimental treatments, all in a controlled environment, for each species. Preliminary results showed marked differences in salinity tolerance. D. spicata grows well in solution cultures up to 500 mM NaCl. P. obtusum dies rapidly in salinities over 250 mM NaCl and will not grow in salinity greater than 125 mM NaCl. An unexplained difference is P. obtusum's poor growth in solution culture as compared to D. spicata. The temperature response curves of net photosynthesis show that maximal rates occur near 40 C for both species with no added NaCl. However, rates of net photosynthesis were quite different between species at all leaf temperatures when grown without NaCl---the rates of D. spicata were twice those of P. obtusum. Growing plants at high salinity reduced net photosynthesis in both species by causing increases in both stomatal and internal resistances to CO2 assimilation. Resistance of P. obtusum was higher than D. spicata in all treatments; thus, D. spicata has a more efficient internal CO2 assimilation mechanism. Leaf water potentials in both species declined with increasing salinity. (Atkins-Omniplan)
W82-06521

AQUACULTURE FOR WASTE MANAGEMENT,
Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W82-06556

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,
Denver Research Inst., CO.
J. G. Milliken, L. C. Lohman, and C. W. Howe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256694, Price codes: A05 in paper copy, A01 in microfiche. OWRT/RU-81/7 Report, August 1981. 87 p, 2 Fig, 13 Tab, 53 Ref, 4 Append. OWRT C-80228-R(8820)(1).

Descriptors: *River basins, *Impaired water use, *Economic aspects, *Saline water, *Monetary benefits, Water reuse, Cost-benefit analysis, Salinity, Tangible benefits, Water quality, Industrial water, Cooling water, Irrigation water, Electric powerplants, Benefits, Reclaimed water, *Colorado River basin.

The cost-effectiveness of selected financial incentives for encouraging reuse of low quality/saline water collected by the U.S. Bureau of Reclamation (USBR) system for electric power plant cooling is analyzed. Penalty costs to water users presently

using saline waters for agricultural/domestic purposes and the potential economic benefits in salinity reduction are identified. Non-quantifiable salinity control benefits were identified as well, in terms of existing/potential beneficial water uses in the 7 Colorado River basin States and general amenity benefits. Further the institutional/regulatory environment in which electric power plants must operate was examined and is described. Comparative costs for saline water reuse for power plant cooling were ascertained. In addition, financial/policy incentives were studied for their relevance to the public power utility and the utility regulatory agency, and for their implementation potential. The most like incentive (capital cost subsidy) was analyzed with existing representative power plant cost data to assess its economic potential. The average cost was below a number of current USBR salinity control projects under consideration for construction. Reuse of saline water by an electric power utility could be a viable and cost-effective method of salinity control. (Zielinski-MAXIMA)
W82-06693

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06707

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
S. T. Chu, and C. G. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256850, Price codes: A03 in paper copy, A01 in microfiche. South Dakota Water Resources Institute Report, May, 1982. 28 p, 7 Fig, 1 Tab, 38 Ref, 1 Append. OWRT A-074-SDAK(1), 14-34-0001-0144.

Descriptors: *Infiltration capacity, *Irrigation design, *Saline soils, *Soil water, *Mathematical equations, Infiltration coefficient, Infiltration index, Infiltration, Infiltration rate, Free water, Irrigation, Soil conservation, Soil contamination, Basins, Runoff coefficient, Sodium, Soil types, Field tests, Mathematical studies, Electrolytes.

Soil infiltration capacity (IC) must be considered for irrigation system design, soil conservation planning, and for evaluating basin runoff yields. The relationship of IC (inches/hour) as a function of electrolyte concentration (EC, meq/liter) of the saturation extract and the exchangeable sodium (Na) percentage (ESP) was examined, as well as ways to improve the mathematical equations used to analytically described IC curves. A field infiltrometer was designed and constructed for field studies; a method incorporating the initial moisture in the profile (antecedent moisture) was developed due to field study difficulties. As an alternative to field study, IC curves were determined on undisturbed soil cores of varying salinity and 2-year irrigation treatment, planted to alfalfa. Study of the curves indicated that there is a continuous effect caused by increasing the Na adsorption ratio from 7.5-30. Watering with high EC water apparently reduces the Na dispersion, an argument having ramifications in sub-humid areas where over half the watering occurs with rainfall of low EC. Analytical study of the mathematical equations describing IC curves indicated that no universal analytical procedure can presently provide consistent estimates of the infiltration characteristics of moist soil over wide soil moisture and cover conditions. (Zielinski-MAXIMA)
W82-06712

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,
Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 2G.
W82-06856

3D. Conservation In Domestic and Municipal Use

WATER CONSERVATION INCENTIVES AND STRATEGY,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243312, Price codes: A04 in paper copy, A01 in microfiche. Report, October 1981. 53 p, 4 Tab, 7 Fig, 69 Ref. OWRT C-90184-C(1), 14-34-0001-9454.

Descriptors: *Water conservation, *Economics, *Water policy, *Drought, Water quantity, Water analysis, Water availability, Water control, Water deficit, Water loss, Water management, Water rates, Water reuse, Water shortage, Groundwater mining, *Renewable resources, *Drought contingency plans.

In 1976, President Carter announced that water conservation would be the cornerstone of his water policy, defining the term to mean reducing inefficiency, wastage and unnecessary usage (and excluding the aspect of 'conserving' water by storing it for future use). Water conservation thus defined has become a popular goal, sometimes advocated with a fervor bordering on the religious. New Jersey,in formulating a Statewide Water Supply Master Plan, has had to deal with water conservation along with economic objectives and engineering methodology. Analysis of the economic theory of Water Resources Development and Planning has been applied to evaluate various policies and issues. This analysis indicates that water conservation has been a slogan rather than a coherent program, that following it as a goal may sometimes be counter productive, and that there is often confusion between a conservation 'ethic' which is an end in itself, and conservation as a means of obtaining various economic objectives. Analysis indicates that outside of groundwater 'mining', water is usually a renewable and reusable resource. During periods of normal precipitation, water conservation should be employed only when the value of the water saved exceeds the cost of affecting the savings. Water conservation is most valuable as a drought contingency tactic. Water conservation as a substitute for structural provision to meet normal water needs is apt to prove shortsighted. (Author abstract)
W82-05906

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,
California Univ., Los Angeles.
E. A. Engelbert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243460, Price codes: A04 in paper copy, A01 in microfiche. Report, August 1978. 48 p, 26 Ref. OWRT (8571)(1).

Descriptors: *Water conservation, *Institutional constraints, *Environmental effects, *Economic aspects, *Decision making, Institutions, Legal aspects, Public participation, Attitudes, Social participation, Regulations, Equitable apportionment, Water law, Water policy, Public policy, Organizations, Federal jurisdiction, Political constraints.

Ten aspects related to incentives and institutions for water conservation are separtely addressed, with general observations and research/action objectives discussed for each. These aspects include: available literature; water conservation concepts (changing perceptions; water needs); public knowledge and awareness (information gaps; cultural patterns/beliefs; education/communication); ethical/equity considerations (individual/group equity; community welfare); environmental aesthetic considerations (environmental water conservation as an integrative-systems process); social/political considerations (community living patterns and life styles; dynamics of social decision-making; the participatory process for citizens in water policy formulation); economic considerations (the pricing system; taxes/subsidies and other financial incentives); water policies (lack of a national conservation policy; integrating water supply and water quality policies and programs; conjunctive management for surface/ground waters; water reclamation/reuse); law and regulations (legal relationships modification; administrative flexibility enhancement; legal conservation incentives); and organizations and administrative arrangements (organizational pluralism/integration; federal-state relationships; political decision-making; bureaucratic attitudes/committments). (Zielinski-MAXIMA)
W82-05922

LEAK LOCATION ENTERS COMPUTER AGE,
New York City Dept. of Environmental Protection, Bureau of Water Supply.
For primary bibliographic entry see Field 7A.
W82-06018

THE IMPACT OF MASS DISTRIBUTION OF WATER CONSERVATION DEVICES AND A WATER CONSERVATION RATE STRUCTURE ON RESIDENTIAL WATER USE,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
W. E. Sharpe, C. E. Young, and K. R. Kinsley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243700, Price codes: A04 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, Report, April 1982. 49 p, 5 Fig, 12 Tab, 25 Ref, 1 Append. OWRT B-112-PA(1), 14-34-001-9092.

Descriptors: *Surveys, *Water rates, *Water use efficiency, *Water users, *User charges, Water use, Water demand, *Water conservation, Urban areas, Water distribution, Water costs, Evaluation, Competing use, Consumptive use, Reasonable use, Conservation, Water supply, Economic aspects, Water control, District of Columbia, Maryland, *Washington Suburban Sanitary Commission.

A study of 545 residential customers of the Washington Suburban Sanitary Commission in the suburban Washington, DC area was undertaken to determine the impacts of mass water conservation device distribution and a water conservation water rate on their long-term water demand. An econometric model was used to assess the impact of the water conservation rate. The study showed a 17% decline in the quantity of water use over the 1974-79 study period. The majority of customers reported changing their habits to use less water; 42% also reported installing water conservation devices. The model output showed a greater decline in water use after the water conservation rate was implemented. High water users reduced their water demand most in response to the rate change. The water conservation rate appeared to increase the use of water conservation devices, and to stimulate greater water use habit modification. Most customers (51%) had no opinion when asked whether they liked/disliked the water conservation rate policy; however, given the choice between decreasing/increasing/uniform rate schedules, only 10% of the residential customers responding preferred the decreasing type of rate schedule. (Zielinski-MAXIMA)
W82-06155

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,
Stanley Consultants, Inc., Muscatine, IA.
For primary bibliographic entry see Field 6C.
W82-06222

WATER RATES AND RESIDENTIAL WATER CONSERVATION,
National Bureau of Standards, Washington, DC.
B. C. Lippiatt, and S. F. Weber.
Journal of the American Water Works Association, Vol 74, No 6, p 278-281, June, 1982. 4 Tab, 14 Ref.

Descriptors: *Water conservation, *Pricing, Water rates, Domestic water, Water users, Economic aspects, Conservation.

The five major types of water rate schedules are explained and discussed in terms of their conservation incentives. Then the rate schedules of a national sample of 90 water utilities are analyzed. Sample means are calculated for selected rate schedule variables, including the correct price for valuing a unit of conserved water and the average price of water. The results indicate that when estimated bill reductions are based on average price, overinvestment in water conservation is likely to result. In addition, the significant price variation found in the results highlights the importance of using local rate schedules, rather than national averages, to value conserved water. (Baker-FRC)
W82-06276

COST-BASED WATER RATE DESIGN,
Norville (Rodney L.) and Co., Houston, TX.
For primary bibliographic entry see Field 6C.
W82-06277

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,
Florida Univ., Gainesville. Dept. of Food and Resources Economics.
For primary bibliographic entry see Field 6C.
W82-06351

POLICING DEMAND THROUGH PRICING,
Fairfax County Water Authority, Merrifield, VA.
For primary bibliographic entry see Field 6D.
W82-06352

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,
Policy Sciences Associates, Boulder, CO.
W. B. Lord, J. A. Chase, and L. A. Winterfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256686, Price codes: A04 in paper copy, A01 in microfiche. Research Report 82-1, January 28, 1982. 58 p, 13 Tab, 3 Fig, 24 Ref, 1 Append. OWRT C-90123-C(1), 14-34-0001-0530.

Descriptors: *Water conservation, *Municipal water, *Water demand, *Evaluation, Attitudes, Behavior, Elasticity of demand, Lawns, Pricing, Rationing(Water), Social values, Alternative regulatory mechanisms, Public acceptability.

A study of public acceptability and potential water use response to a variety of municipal water conservation policy options was conducted in three Colorado Front Range communities in the 10,000 to 100,000 population range. The study was focused upon water used for lawn watering, because it accounts for nearly half of total residential water use and for a much greater share of both consumptive water use and water system peak load requirements. Policies which provided water conservation information were the most acceptable. Policies which rewarded people who took conservation actions and some policies which included restrictions on water use were acceptable to most. Penalties and restrictions perceived to be inequitable or severe were unacceptable. Conservation pricing was moderately acceptable and was one of the more effective policies in achieving water use reductions. Most respondents preferred increasing or inverted block pricing to the more common declining block pricing policy. Public information would be a desirable component of any municipal water conservation program. Conservation pricing deserves prime consideration for a utility emphasizing either effectiveness or financial feasibility. A utility emphasizing acceptability will face a difficult choice, because there tends to be an inverse relationships between acceptability and effectiveness. (Author abstract)
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,
Nevada Univ. System, Reno. Desert Research Inst.
J. W. Fordham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256793, Price codes: A04 in paper copy, A01 in microfiche. Publication No 41073, April, 1982. 58 p, 9 Fig, 18 Tab, 37 Ref. OWRT A-095-NEV(1).

Descriptors: *Water use, *Mathematical models, *Projections, *Hydrologic budget, *Competing use, Computer models, Mathematical studies, Model studies, Forecasting, Prediction, Water availability, Induced infiltration, Water requirements, Alternative water use, Groundwater recharge, Urbanization, *Nevada, Truckee Meadows.

Water use changes during the past decade and water use projections to the year 2000 are described for the truckee Meadows valley, which hosts one of the fastest growing metropolitan areas in the U.S. (Reno/Sparks). Identified and quantified are: the added urban use in previously undeveloped areas; the water need changes for areas transformed from agriculture to urban; the reduction in induced groundwater recharge to the Truckee Meadows. A simplified water balance model which incorporated inflow of tributary streams, average river flows, precipitation, and temperatures was used to develop current and projected water budgets, providing a balance by diverting waters by source, river, tributary, or groundwater, and accounting for losses and returns to the river system. The projected total diversion for the Meadows from surface sources in the year 2000 (132,000 acre-feet/year) remains below total water rights currently allocated. Induced recharge is projected to decline (by about 25%) by 5040 acre-feet/year due to urbanization. Urban runoff is projected to increase about 4350 acre-feet/year for the same reason. The results depict a water balance for the Meadows at the current area development rate, since growth rate and land use change have slowed significantly since 1979. The net difference between inflow and outflow is equal to the total annual loss expected under each level of development. (Zielinski-MAXIMA)
W82-06705

COUNTY PROVIDES A RURAL WATER SUPPLY SYSTEM,
URS Engineers, Seattle, WA.
W. L. Berschauer, and N. Miller.
Public Works, Vol 113, No 7, p 63-65, July, 1982.

Descriptors: *Public utility districts, *Political aspects, *Water supply, Water distribution, Municipal water, Gardiner, *Washington, Jefferson County, Utilities.

The 200 residents of Gardiner, Washington, lacking sufficient groundwater supplies, petitioned the Jefferson County Public Utility District (PUD) 1 in 1976 to investigate the feasibility of a community water system. After a test well located a large aquifer with excellent water quality, the Farmers Home Administration agreed to finance the project with a $1 million loan. After a public hearing in November 1979, Local Utility District No. 1 was established. The system, comprising 7 miles of distribution main, two concrete storage tanks, two pressure reducing stations, a booster pump station, and a well pumping station, was placed in service in August 1981. The PUD is currently studying other requests for similar water systems in its jurisdiction. (Cassar-FRC)
W82-06843

3E. Conservation In Industry

REORGANIZATION OF GROUNDWATER UTILIZATION SOUGHT (NEUORDNUNG DER GRUNDWASSERVERWENDUNG ANGESTREBT),
H. Keune.
Wasser, Luft and Betrieb, Vol 26, No 1/2, p 14-16, 1982. 1 Tab, 15 Ref. (No English summary).

Descriptors: *Groundwater management, *Industrial water, *Water districts, *Water law, Water supply, Water scarcity, Surface water, Costs, Water conveyance, Economic aspects, Administrative regulations, Public policy, Federal Republic of Germany.

The 1981 'water crisis' in the Federal Republic of Germany precipitated efforts to reduce industrial consumption of groundwater. While this actually decreased between 1975 and 1977, some statistics did not reflect this, because recharged groundwater and bank filtrate were counted as surface water by the public water authorities, but as groundwater by industry. The fact that industrial demand is significantly less than public demand and that only in certain regions is there competition for the groundwater supply means that this issue can be resolved locally. The suggestion that industry release water from its wells to the public supply in exchange for nonpotable water at no cost to either party is impractical due to lack of suitable water and pipelines, administrative difficulties, and costs. The suggestion that industry be permitted to use groundwater only when this comes from the public supply is also impractical, as chlorinated or otherwise disinfected water is not always suitable for industrial use. Rationing plans are not likely to be instituted in the foreseeable future due to technical difficulties. The only remaining option is conventional water law, which can provide restrictions on the issuing of permits and concessions for groundwater use. (Gish-FRC)
W82-06022

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6D.
W82-06160

WASTE-HEAT VERTICAL TUBE FOAM EVAPORATION FOR COOLING TOWER BLOWDOWN RENOVATION/RECYCLE,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton, and K. Someahsaraii.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256629, Price codes: A07 in paper copy, A01 in microfiche. Report, February, 1982. 114 p, 32 Fig, 9 Tab, 22 Ref. OWRT C-90052D(0427)(1).

Descriptors: *Cooling towers, *Power plants, *Heat transfer, *Waste heat, *Water reuse, Cooling water, Industrial water, Heat exchangers, Heat, Water use, Reclaimed water, Industrial plants, Thermal water, Heated water, Environmental engineering, Engineering, Energy loss.

A prototype waste-heat vertical tube foam evaporation (WH-VTFE) plant was designed, constructed, and field-tested for reducing power plant cooling tower blowdown to a small residual volume of solids slurried in brine, while producing distilled water for reuse. Facility design was based on previously-developed pilot plant test data. The WH-VTFE facility was constructed for initial parametric testing in demonstration phase was conducted at a power plant site using turbine exhaust steam for the up to 50-fold cooling tower blowdown concentration in a foamy-flow seed-slurried mode of downflow vertical tube evaporation. The VTFE heat transfer coefficient ranged between 5600-9000 W/sq m/degree, a sufficient temperature difference is available within a typical power plant heat rejection system to operate a WH-VTFE when the plant load is above 50% of its design capacity. Scale formed from inadequate brine recycle rates was readily removed by recycling fresh water through the evaporator to restore the high heat transfer performance of the WH-VTFE. It was concluded that WH-VTFE was demonstrated as feasible and commerically viable. (Zielinski-MAXIMA)
W82-06369

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,
Energy Policy Studies, Inc., Omaha, NE.
M. W. Gilliland, and L. B. Fenner.
Resources and Conservation, Vol 6, No 3/4, p 167-185, 1981. 5 Fig, 4 Tab, 18 Footnotes.

Group 3E—Conservation In Industry

Descriptors: *Water conservation, *Energy, *Agriculture, *Water management(Applied), Irrigation efficiency, Canal linings, Cooling water, Electric power industry, San Juan River, *New Mexico, Colorado River Basin, Coal mining, Gasification, Water requirements.

Impacts of five water management options and non-management are described for the San Juan County, New Mexico, region in the Upper Colorado River Basin. The five strategies chosen for evaluation are canal lining, canal lining with sprinkler irrigation, all dry cooling of energy producing plants, combination wet/dry cooling of energy producing plants, and reuse of uranium mining discharge water as cooling water for gasification plants. Results of evaluating water quantity, instream flows, and water quality showed that improved agricultural irrigation efficiencies and dry cooling in the energy industry will have little effect on water quantity and quality over the next 20-25 years. In the San Juan River, water flow at Shiprock will decrease from 56,200 liters per sec at present to 35,300 liters per sec with no management. Conservation measures are expected to produce flows of 35,700-38,300 liters per sec. During 1 to 3 months of the year, flows will be insufficient to maintain good instream conditions, depending on the water management strategy used vs. 3 months with no management. Likewise, salinity at three stations will increase by 17% with no management and slightly less with the management options studied. Overall, dry cooling in the energy industry would reduce projected water depletion by 10%, salinity by 2%, and instream impacts by 8%. The agricultural conservation measures would not change water depletion, and would reduce projected salinity increases by 5% and instream impacts by 4%. The minor improvements are cost effective for the energy industry but not for agriculture. (Cassar-FRC)
W82-06517

3F. Conservation In Agriculture

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6B.
W82-05909

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 3C.
W82-05920

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W82-05921

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
S. Kim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243486, Price codes: A07 in paper copy, A01 in microfiche. Report, September 1981. 122 p, 21 Fig, 16 Tab, 49 Ref, 5 Append. OWRT B-041-IDA(4). 14-34-0001-8079.

Descriptors: *Irrigation practices, *Flow discharge, *Prediction, *Irrigation requirements, *Time series analysis, Irrigation districts, Irrigation water, Influent water, Water use, Model studies, Forecasting, Projections, Water use efficiency, Model testing, Statistical methods, Mathematical studies, Computer programs, Evapotranspiration, *Idaho.

Daily water flow data from two large irrigation districts in the Upper Snake River over three irrigation seasons (1978-1980) were analyzed and methodology was investigated for the predictions of daily water diversions. Crop consumptive water use, estimated by the combination method on a daily basis, varied greatly on a daily basis, and its pattern was quite different from year-to-year. In addition, seasonal irrigation use levels were different for different years for the districts, while seasonal water use patterns were similar for the different years and districts. Fluctuations, and relations among inflow, outflow, evapotranspiration, and precipitation were assessed using graphical and statistical methods. A slight change in evapotranspiration was found to cause a rather large change in inflow. A weekly cycle was found to exist within outflows, but no significant frequency was found within inflows. Time and diversion interrelationships were established, and, based on the time effects, proper consumptive irrigation requirements were estimated at the district level. The methodology developed for predicting water diversions took the form of a computer program, and was observed to provide reasonable predictions for the study area. (Zielinski-MAXIMA)
W82-05924

CABLEGATION: II. SIMULATION AND DESIGN OF THE MOVING-PLUG GATED PIPE IRRIGATION SYSTEM,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid, and W. D. Kemper.
Transactions of the ASAE, Vol 25, No 2, p 388-395, March/April, 1982. 13 Fig, 1 Tab, 12 Ref.

Descriptors: *Cablegation, *Irrigation design, *Pipe flow, Furrow irrigation, Infiltration, Automation, Orifice flow.

The cablegation irrigation system consists of a surface pipe, laid on a slope at the head end of a field, which serves as both the conveyance and distribution pipe. Gates or holes near the top of the pipe are left open. Water is introduced at a flow rate less than the free surface flow capacity of the pipe. A plug, restrained by a cable, is allowed to move down the pipe at a slow rate, causing water to flow out of the holes upstream from the plug. and thus moving the entire flow across the field. This paper develops a simulation model to predict the time distribution of orifice flow, the distribution of infiltrated water across a field, and runoff rates. The model is usable for designing cablegation systems for fields with variable pipe slopes and variable furrow lengths. To obtain the optimum net water application and keep furrow stream sizes within acceptable limits the orifice size along the pipeline and the plug travel speed are varied. The system has been successfully operated at pipe slopes between 0.0026 and 0.022. It is especially well suited to cases where the furrow width is narrow relative to the total width of the field. (Cassar-FRC)
W82-05963

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
W. D. Kemper, B. J. Ruffing, and J. A. Bondurant.
Transactions of the ASAE, Vol 25, No 2 p 333-339, 343, March/April, 1982. 7 Fig. 2 Tab. 15 Ref.

Descriptors: *Irrigation practices, *Infiltration rate, *Compacted soils, *Furrow irrigation, Water management, Soil compaction, Sprinkler irrigation, Soil properties, Water temperature.

Many farmers have abandoned the energy-intensive sprinkler irrigation method in favor of a return to furrow irrigation. One problem with furrow irrigation is decreased crop yields caused by nonuniform water distribution. A study of furrow intake rates produced several suggestions for improving uniformity of water distribution. Intake uniformity can be improved by restricting tractor traffic to tracks that are not used for irrigation, compacting corrugates in which water will run so that the soil on the perimeter has a lower infiltration rate than the rest of the soil, reducing flow rate, using longer runs and smaller pipe sizes, compacting soil in selected areas, applying straw to furrows where increased infiltration is desired, and decreasing the slope at the lower ends of the fields. (Cassar-FRC)
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliot, and W. R. Walker.
Transactions of the ASAE, Vol 25, No 2, p 396-400,March/April, 1982. 4 Tab, 8 Ref.

Descriptors: *Infiltration, *Irrigation, *Furrow irrigation, *Colorado, Advance functions, Kostiakov-Lewis function, Soil properties, Volume balance method, Field tests, Soil water, Mathematical equations.

Furrow infiltration and advance functions were evaluated in three Colorado farm soils (clay loam, loamy soil, and loam to clay loam). Lengths of irrigated runs were 350-625 m and furrow slopes 0.25-1%. Data were used to study infiltration and advance relations based on a kinematic or volume balance approach. The Kostiakov-Lewis function modified by a term for the asymptotic long time infiltration rate was highly effective in simulating infiltrated volumes when reliable estimates of the steady infiltration rate could be obtained. The power curve form of the advance function was better fitted using the two-point method than using regression. (Cassar-FRC)
W82-05969

IRRIGATION REQUIREMENT OF HIGH-YIELDING RICE VARIETIES GROWN ON SOILS HAVING SHALLOW WATER-TABLE,
Central Rice Research Inst., Cuttack (India).
K. P. Jha, D. Chandra, and Challaiah.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 732-737, October, 1981. 5 Tab, 10 Ref.

Descriptors: *Irrigation requirements, *Rice, *Water use efficiency, *India, Water table, Grain crops, Crop yield.

High-yield rice varieties under limited irrigation produced grain yields comparable to rice grown under continuous or partial flooding of fields. The study, conducted during the winters of 1976-78 in sandy loam alluvial soil with a winter water table depth of 35-52 cm, used four irrigation treatments: I1, continuous flooding; I2, irrigation (7 cm) at moist conditions, 2-3 days after disappearance of ponded water from the field; I3, flooding at tillering and flowering but irrigation at moist conditions at other stages; and I4, irrigation (7 cm) at 30-35 mm of cumulative pan evaporation. Treatment I1 required 1403-1600 mm irrigation water, I2, 887-910 mm; I3, 1073-1097; and I4, 793-840 mm. Water use efficiencies were: I1, 2.48-2.97; I2, 4.17-4.42; I3, 3.26-3.77; and I4, 3.84-5.27 kg grain/mm water. The short duration Pusa variety (114 days) had higher water use efficiency than the other varieties, Supriya (132 days) and Vani (143 days). (Cassar-FRC)
W82-05971

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
For primary bibliographic entry see Field 2I.
W82-05972

THE EFFECT OF SHORT-TERM WATERLOGGING DURING FURROW IRRIGATION OF COTTON IN A CRACKING GREY CLAY,
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
A. S. Hodgson, and K. Y. Chan.
Australian Journal of Agricultural Research, Vol 33, No 1, p 109-116, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Irrigation, *Cotton, Crop yield, Crop production, *Waterlogging, Irrigation practices, Agriculture, *Furrow irrigation.

The effects of waterlogging on plant and soil were studied by subjecting cotton to periods of inundation at successive irrigations ranging from 4 to 16 hours in a cracking grey clay. The growing season was hot and dry and effects of waterlogging were not aggravated by rainfall or excessively overcast conditions. Plant growth was virgorous and visual symptoms of waterlogging were limited to a low section of the field where plant leaves became chlorotic in late February and prematurely senesced. Similar symptoms were noted for cotton which was waterlogged during flowering and boll setting in other reports from northern Australia valleys. Waterlogging treatment in this experiment had little effect on leaf area index, dry matter per square meter and plant height. In most cases the 8, 12, or 16 hour treatment effects were not significantly different. Any existing differences were reflected in final lint yields, where the 4 hr treatment yields were significantly higher than the 12 and 16 hr yields, and the 8, 12, and 16 hr yields were not significantly different. It was concluded that lint yield is likely to increase if cotton crops are irrigated and drained faster to reduce contact time. The farmer may achieve this by using larger siphons, more siphons per furrow, shorter fields or steeper slopes. (Baker-FRC)
W82-06010

THE EFFECT OF ELECTRICITY PRICES, LIFT, AND DISTANCE ON IRRIGATION DEVELOPMENT IN IDAHO,
Idaho Univ., Moscow.
J. R. Hamilton, G. S. Barranco, and D. J. Walker.
American Journal of Agricultural Economics, Vol 64, No 2, p 280-285, May, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation, Model studies, *Irrigation practices, Crop yield, *Idaho, Economic aspects, Agriculture, Crop production, Prices.

Parametric budgeting was used to simulate the impacts of variations in farm size, crop prices, crop yields, electricity rates, lift height, and distance from the river on the private economic feasibility criterion currently being used by the US Bureau of Land Management. Maximum feasible lift heights and carry distances are identified, and developable acreage through irrigation programs is estimated. An obvious limitation of the parametric budgeting procedure used is its omission of financial tax incentives which may accrue to some operators. The model is also limited by its partial equilibrium nature. Management options such as irrigation system alternatives or crop changes in response to higher electricity prices were not considered. Results of the study indicate that per acre returns on irrigated tracts increase slightly with farm size. Under base conditions all farm sizes examined could sustain nearly a 10% decline in crop price or yields. Given the base lift, 550 feet, and the base distance, 5 miles, all farm sizes considered could sustain a 100% increase in electric rates. However, with a 200% power rate increase, irrigation feasibility would be limited to the largest farms with lifts less than 550 feet and distances less than 4 miles. Of the lands in the BLM study area, all but the highest and most distant could be developed under base yields, prices, and power rates. However, plausible increases in power rates could limit development to low lift land near the river, sharply reducing the total feasible acreage. The criteria being used by the BLM would permit development of more land than meets social criteria but not enough to meet private demands. (Baker-FRC)
W82-06017

MOISTURE CONSERVATION OF INTERSEEDED GRASSLANDS THROUGH THE USE OF ANNUAL AND PERENNIAL CROP BARRIERS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
F. R. Vigil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243635, Price codes: A04 in paper copy, A01 in microfiche. South Dakota Water Resources Institute, Brookings, Report, December 1981. 53 p, 17 Tab, 11 Ref, 4 Append. OWRT A-069-SDAK(1), 14-34-0001-9044.

Descriptors: *Soil moisture deficiency, *Grasslands, *Standing crops, *Alfalfa, Moisture content, Moisture stress, Seed treatment, Seeds, Snow management, Soil water, Barriers, Crop production, Wheatgrasses, Sorghum, Planting management, Drilling equipment.

Interseeding, a method of introducing alfalfa into the range with only a partial disturbance of the existing vegetation, is used to improve forage resources in South Dakota. Since moisture was considered as the principal factor in determining whether a stand would succeed or fail, perennial (Tall wheatgrass) and annual (sorghum and sunflowers) crop barriers were planted on native ranges from 1978-81 in an effort to conserve moisture through snow retention. These barriers failed to establish in all four years, which may be due in large part to fungalnematode interactions. Large areas in the State were discovered to be having difficulty in establishing legumes, even under irrigation. Fungicide seed and soil treatment, nematicides, and biological control methods for controlling damping-off disease (caused by Pythium spp. and nematodes) were tested for alfalfa stand establishment. Other causes for failure of establishing annual/perennial crop barriers into a growing grass sod are suggested. A newly-developed drill for interseeding into semi-arid rocky environments is reported. (Zielinski-MAXIMA)
W82-06148

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-06156

SPRINKLER LEVELER AND WIND COMPENSATING DEVICE,
Wade (R. M.) and Co., Portland, OR.
G. Cornelius.
U.S. Patent No 4,204,643, 8 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1261, May 27, 1980.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A main irrigation pipe with wheels has mounted along its length movable sprinkler heads. Each sprinkler head has a flat, bladelike member, the weight of which aids in urging that sprinkler head toward an erect position. Meanwhile the bladelike member compensates for wind by leaning the sprinkler head into the wind to provide a more even distribution of water. (Sinha-OEIS)
W82-06164

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 2G.
W82-06172

EFFECT OF IRRIGATION FREQUENCY AND NITROGEN ON GROUNDNUT YIELD AND NUTRIENT UPTAKE,
Andhra Pradesh Agricultural Univ. (India). Dept. of Agronomy.
S. R. Reddy, P. S. Chalam, G. H. S. Reddi, and A. P. Raju.
Plant and Soil, Vol 65, No 2, p 257-263, 1982. 2 Tab, 13 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Groundnuts, *Potassium, *Nitrogen, Nutrients, Phosphorus, Soil moisture, Moisture availability.

Field experiments were conducted during the summers of 1979 and 1980 to study the effect of irrigation frequency and levels of nitrogen on yield and uptake of the major nutrients by Spanish groundnut. The soil was sandy loam, with a low moisture retentive capacity, low in available nitrogen and low in available potassium. The soil was moderately alkaline in reaction with a pH of 8.3. Four irrigation frequencies were used during the study, including irrigation at 1,4,6, and 8 cm cumulative can evaporation (CCE) corresponding to irrigation once in 3,5,7, and 10 days, respectively. Four levels of nitrogen were also used, 0,20,40 and 60 kg N/ha. Nitrogen, phosphorus (35 Kg P/ha) and potasssium (60 kg K/ha) were applied in the form of urea, single superphosphate and potash, respectively. Pod yield of groundnut was highest at 3,293 kg/ha when irrigations were scheduled at 4 cm cumulative can evaporation, equivalent to once every 5 days. The addition of N did not increase pod yield. N and P uptake by the crop was greatest with high frequency of irrigation of scheduling irrigation at 4 cm CCE. The highest uptake of N and P was with a combination of 20 kg N/ha and high frequency irrigation. Potassium uptake was low with low irrigation frequency, while it was highest at 20 kg N/ha. (Baker-FRC)
W82-06230

DESIGNING FOR DEFICIT IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, and G. S. Nuss.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 91-106, June, 1982. 2 Fig, 8 Tab, 8 Ref. OWRT 14-31-0001-2139.

Descriptors: *Irrigation practices, *Irrigation design, *Deficit irrigation, Wheat, Oregon, Water conservation, Economic analysis, Crop yield, Cost analysis, Evapotranspiration, Energy, Capital costs, Benefits.

Two irrigation systems, one for full irrigation and one for deficit irrigation, were designed for a farm in eastern Oregon growing winter wheat. A comparison of costs and performances for the two systems showed that deficit irrigation increased farm income and reduced energy, water, and capital requirements. The full irrigation system schedule was two sets per day (11 hours each set), 2.3 inches gross water applied per set, 32 inches gross water applied per season, and a 6 day minimum interval between irrigations. The root zone would not be depleted by more than 50% between irrigations. The deficit irrigation scheme specified soil moisture depletion in excess of 50% of available water during times of peak demand. The irrigation schedule was two sets per day (11 hours each set), 3.15 inches gross water applied per set, 20 inches gross water applied per season, and a 12 day minimum interval between irrigations. Using the water saved by deficit irrigation allowed the 92 acre plot to be extended to 143 acres, increasing net farm income by 42%. The amounts of benefits from deficit irrigation are dependent on system design and many other factors. Each case must be completely analyzed individually to determine the merits of deficit irrigation. (Cassar-FRC)
W82-06334

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,
Texas Water Resources Inst. College Station.
D. Lacewell, C. Hardin, J. A. Petty, and E. Whitson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256678, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 119, May, 1982. 52 p, 16 Tab, 1 Fig, 26 Ref. OWRT A-045-TEX(3). 14-34-0001-9046, 0146, and 1146.

Descriptors: *Irrigation, Water efficiency, Economics, *Texas High Plains, Texas Trans-Pecos,

Ogallala, Economic impact, Model studies, Linear programming.

Resursive linear programming models for a typical Texas High Plains irrigated farm were developed to evaluate expected impact of energy and crop price changes, tenure and new technology. The model includes a Fortran sub-routine that adjusts irrigation factors each year based on the linear programming solution of the previous year. Increased natural gas prices impact heavily on returns above variable costs (up to 15 percent reduction for a 60 percent natural gas price increase). Annual net returns were reduced by as much as 30 percent, and the present value of returns to water was reduced by as much as 80 percent as the natural gas price was increased annualy by $0.25 per mcf (from $1.50 per mcf). Increasing pump efficiency from 50 to 75 percent can improve farm profits over time; e.g., the present value of groundwater was increased 33 percent for a typical farm with an aquifer containing 250 feet of saturated thickness and 15 percent for 75 feet of saturated thickness. Results indicate that irrigation can be extended by 11 or more years with 50 percent improved distribution efficiency. In addition, the increase in present value of groundwater on the 1.69 million irrigated acres of the Texas High Plains was estimated to be $995 million with 50 percent improved efficiency. Wind assisted irrigation pumping could be an economically viable alternative if costs decrease and stabilize. The results are limited by uncertainties of the long-term characteristics of wind system operation.
W82-06374

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1.
Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1082 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigatiion, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This first volume of a 2-volume textbook set covers 7 topic areas concerning engineering aspects of irrigated lands. Following a general introduction covering human, social, economic, administrative, financial, and technical aspects, detailed attention is given to hydrologic and hydraulic topics related to irrigated land. Specific topics address the areas of: meteorology and climatology; surface hydrology; hydraulics and hydrology of underground waters; use of underground waters; evaluation and classification of soils; and farming and irrigated land. Meteorologic/climatologic aspects include specifics on solar radiation, precipitation, drought, and erosion. Surface hydrology materials includes deep valley characteristics, laws of distribution, copious water, flooding, and calculation methods. Underground water topics include hydraulics and movement, water balance, methods of variation, water quality and analysis, and recovery systems. The discussion on soils includes chemical composition, reactions, erosion characteristics and modeling, and sedimentation. Farming aspects cover farming and climate, and limitations in the choice of proper surface farming. Twelve additional topic areas covering engineering aspects of irrigated lands are covered in Volume 2. (Zielinski-MAXIMA)
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,
Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1236 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigation, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This second volume of a 2-volume textbook set covers 12 topic areas concerning engineering aspects of irrigated lands. Specifically, these topic areas address: equipment and methods of irrigation; networks of irrigation by gravity networks of irrigation by pressure; practical methods of investigation of irrigated canals; agricultural drainage; road networks; electrical limits; grading of lands; agricultural and hydraulic development; economic feasibility; organization and legislation; and a model of agrarian planning. A detailed annotated list of definitions of hydroagronomy terms is also included. Seven additional topic areas concerning engineering aspects of irrigated lands are covered in Volume 1. (Zielinski-MAXIMA)
W82-06376

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 18, No IR2, p 127-141, June, 1982. 10 Fig, 8 Ref.

Descriptors: *Irrigation design, *Basin irrigation, Infiltration, Design criteria, Mathematical equations, Gravity flow, Soil classification.

A previous method for designing level irrigation basins is extended to cover a wider range of infiltration conditions. The limit of the basin length is determined. It depends on application depth, infiltration conditions, roughness, and the desired uniformity. A 6-step procedure for designing level basins is detailed and an example given for alfalfa on a silt loam with moderate infiltration rate. The steps are as follows: (1) determine design conditions (uniformity, net infiltration depth, time required to infiltrate net depth, exponent of infiltration function, and roughness from 004 for bare soil to 0.25 for dense sod crops): (2) calculate reference values for basin length and unit flow rate; (3) determine approximate limit on basin length; (4) determine a value for basin width; (5) determine application time (equations are given for uniform or irregular basins); and (6) consider other limitations such as soil variability, practical considerations of field dimensions, and surface roughness of the field. Design conditions should be evaluated for different types of crops and for different conditions throughout the growing season. (Cassar-FRC)
W82-06452

RESPONSES OF 6-YEAR-OLD DIAMOND GRAPEVINES TO THE CHANGE FROM SPRINKLER TO TRICKLE IRRIGATION AND TO THE TIME AND METHOD OF APPLYING NITROGEN,
Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Journal of Soil Science, Vol 61, No 4, p 571-575, November, 1981. 4 Tab, 7 Ref.

Descriptors: *Nitrogen, *Trickle irrigation, *Crop yield, *Sprinkler irrigation, Irrigation effects, Irrigation practices, Fruit crops, Fertilizers, *Grapevines, *Pacific Northwest U.S.

Little research has been conducted on the performance of grapevines under trickle irrigation in the Pacific Northwest, where wine grapes have become an important crop. A vineyard which had received regular cyclical sprinkler irrigation for the first 6 years of its existence was changed to trickle irrigation to determine how well the mature vines would adapt to the point-source method of irrigation. Water application was reduced by about 20% under trickle irrigation. The Diamond grape yield was measured for 3 years, after which nitrogen fertilizer tests were conducted for 3 years to determine whether significant changes in the fertilizer program were needed with trickle irrigation. The change from sprinkler to trickle irrigation caused no detectable growth or yield changes of the grapevines or fruit. Fertilizer tests under trickle irrigation demonstrated no significant Diamond grape yield differences between fall and spring broadcast nitrogen fertilizer or between either of those treatments and spot placement of nitrogen under trickle emitters in two of three seasons. None of the treatments had any effect on soluble solids or the titratable acidity of the grape berries or on the percent petiole nitrogen. (Carroll-FRC)
W82-06492

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,
Energy Policy Studies, Inc., Omaha, NE.
For primary bibliographic entry see Field 3E.
W82-06517

AUTOMATION OF A SPRINKLER IRRIGATION SYSTEM BY THE UTILIZATION OF REAL TIME WEATHER INFORMATION,
Nebraska Univ. Panhandle Station at Scottsbluff.
A. Weiss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256710, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center, Lincoln. June 1982. 39 p, 4 Fig, 1 Tab, 39 Ref. OWRT A-064-NEB(1), 14-34-0001-1129.

Descriptors: *Sprinkler irrigation, *Mathematical equations, *Evapotranspiration, *Crop yield, *Weather data collections, *Automation, Irrigation, Evapotranspiration control, Irritation efficiency, Irrigation engineering, Irrigation practices, Irrigation design, Irrigation water, Soil water, Soil moisture deficiency, Farming, Weather patterns.

A method is described for quantitatively calculating reference crop evapotranspiration (ET), based on sound physical principles with a minimum of empiricisms. The method uses the Doorenbos and Pruitt version of the Penman equation for ET calculation. Using refeence crop ET as an input, the actual crop ET, acutal and percentage soil water depletion are determined using crop coefficient curves based on growing degree days. This approach to irrigation scheduling was used in conjunction with an automated weather station to schedule irrigation of two fields of dry edible beans grown under center pivot systems. Yields obtained from both fields were above-average, compared to the average yield for the region. However, actual automation of an irrigation system was not accomplished due to reluctance of the cooperative farmer allied to the study in permitting independent automated control of his center pivot irrigation system. While irrigation scheduling information is a valuable tool to the farmer, he desires to reserve the right to decide when to irrigate. Nonetheless, the procedural information developed in this study can assist the use of networks of automated weather stations to provide information on irrigation scheduling on a regional basis. (Zielinski-MAXIMA)
W82-06695

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,
South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W82-06712

COMPUTER SIMULATION OF SURFACE IRRIGATION BY MEANS OF NUMERICAL METHODS FOR FINDING OPTIMAL PARAMETERS,
Vsesoyuznyi Naucho-Issledovatelskii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
R. M. Kiladze.
Water Resources, Vol 8, No 3, p 312-318, May/June, 1981. 2 Fig, 3 Tab, 23 Ref. Translated from Vodnye Resursy, N0 3, p 146-153, May/June, 1981.

Descriptors: *Irrigation efficiency, *Numerical analysis, *Optimization, Computers, Surface irrigation, Border irrigation, Furrow irrigation, *Simulation analysis, Model studies, Mathematical models, Inflitration.

The best sets of controlling parameters in surface irrigation, border and furrow types, were determined by use of a numerical model. Four criteria for evaluating quality of irrigation were obtained and expressed as equations: degree of moistening of the active soil layer, efficiency of water use, productivity of mechanisms (dependent on length of furrows or border strips), and productivity of labor (dependent on labor, slope, and type of soil). Constraints were derived, including maximum permissible velocity of the irrigation stream, maximum permissible depths during irrigation, and desired rate of irrigation (ha per day). In an example, irrigation was simulated for each possible set of controlling parameters. A set of results which satisfied the constraints was presented in a table. These Pareto-optimal solutions can be further evaluated by the persons responsible for decision making. (Cassar-FRC).
W82-06781

FARM WATER MANAGEMENT GETS FAO BOOST,
World Water, Vol 5, No 6, p 33, 35-36, June, 1982.

Descriptors: *Water management, (applied), *Irrigation efficiency, *Developing countries, Education, Food and Agriculture Organization, Farm management, Organizations, Pilot tests.

In October 1980 the U.N. Food and Agriculture Organization (FAO) started a program for assisting governments of developing countries in promoting improved irrigation efficiency among small farmers. To overcome the shortage of personnel for training the farmers in the field, special courses were given high priority in educational institutions. Demonstration projects at the farm and village level were conducted in several countries. A pilot project in Pakistan, established before the FAO's action, contributed much background information in this effort. The social and physical constraints on good farm water management are usually inadequate operation of the main system, unreliable water delivery, inadequate operation of the main system, unreliable water delivery, inadequate farm size, tenure systems, and water rights. In the Philippines a pilot irrigation management project begins with a community organizer who lives in the locality and identifies needs through contact with the people. Later an engineer prepares a project design and cost estimates. A farmers' association is formed, and financing is provided by contributing labor and long-term loans. The Philippine program has produced 180 new irrigation systems since 1980 and substantial increases in rice production. Similar projects are underway in Sri Lanka, Egypt, Malaysia, Panama, Indonesia, Thailand, Bangladesh, South Yemen, Tanzania, Ghana, and Kenya. (Cassar-FRC)
W82-06815

DOUBTS REMAIN ABOUT BURA ECONOMICS,
World Water, Vol 5, No 6, p 46, 49, June, 1982. 1 Fig.

Descriptors: *Developing countries, *Irrigation, *Economic aspects, *Benefits, Bura Project, Tana River, *Kenya, Capital costs, Farms, Semiarid lands, Water resources development, Canals, Irrigation Canals.

The Bukra project in eastern Kenya has far exceeded original cost estimates, leaving the government with massive debts to repay. The project is opening a previously unfarmed, sparsely populated 6700 ha of semiarid land to settlers. High capital costs of $30,000 per family settling on 1.25 ha plots include housing, water supply, and other facilities. A recent economic evaluation estimated a return of 6.75% over the next 50 years, much less than the 13% predicted by the World Bank in 1977. Some major factors are the drop in cotton prices since the plan was conceived, increased costs, delays in construction, and high management and operation costs. The Bura scheme obtains water from the Tana River by diesel pumping through a 27 km supply canal, a 25 km main canal, 4 main branch canals, innumerable feeder canals, and siphon tubes. (Cassar-FRC)
W82-06816

COMPUTER-GUIDED LINEAR IRRIGATOR MARCHES ON,
World Water, Vol 5, No 6, p 53-54, June, 1982.

Descriptors: *Irrigation efficiency, *Computers, Water conservation, Wind, Spray irrigation, Mist irrigation, Irrigation equipment.

The Noble linear low pressure overhead irrigation system has been effective in the hot (up to 50 C) and windy (up to 80 km per hour) Mojave Desert. The diesel-powered apparatus combines computer technology and sophisticated nozzles for mist spray water delivery. Water is supplied through a buried mainline with risers onto which grabber tractors fix by computer command, ensuring constant distribution. Spraying is uninterrupted because one grabber is supplying water while the second is seeking out the next riser. Wind problems are almost eliminated because the spray booms are just above the head of the crop. Water savings are about 25%. Runoff, fertilizer teaching, and soil erosion are virtually eliminated. Computer cards allow the operator to quickly reprogram the apparatus for a chosen speed, water delivery ratio, or program. (Cassar-FRC)
W82-06817

BRANTAS DAMS TRIGGER NEW JAVANESE DEVELOPMENT,
World Water, Vol 5, No 6, p 40-41, June, 1982. 1 Fig.

Descriptors: *Irrigation, *Developing countries, *Dam construction, *Irrigation design, Water resources development, Dams, Brantas River, Java, *Indonesia, Crop yield, Lodoyo Project.

The Lodoyo irrigation project, soon to be completed in Java, will cover about 15,000 ha of land of which 9600 ha were not formerly cultivated and 6000 ha produced only one crop per year instead of the 2-3 crops per year possible with the new irrigation project. Water comes from below the Wlingi Dam on the Kali Brantas, a river which runs in a circular course around an active volcano. The Lodoyo project, consisting of a 32 km main canal, secondary and tertiary canals, will benefit about 450,000 people. Agricultural extension services are a part of the project. (Cassar-FRC)
W82-06818

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
B. Sherman, and V. P. Singh.
Water Resources Research, Vol 18, No 3, p 659-667, June, 1982. 7 Fig, 21 Ref.

Descriptors: *Model studies, *Surface irrigation, Kinematic waves, Kinematic wave theory, Soil water, Mathematical studies, Waves, Irrigation, Infiltration, Infiltration rate.

The kinematic model for surface irrigation as reported previously by Sherman and Singh is extended. Depending on the duration of irrigation and time variability of infiltration, three cases are distinguished. Explicit solutions are obtained when infiltration is constant. For infiltration varying over time, a numerical procedure is developed which is stable and has fast convergence. A rigorous theoretical justification is developed for computation of the depth of water at and the time history of the front wall of water advancing down an infiltrating plane or channel. A derivation is given of the continuity and momentum equations when there is lateral inflow and infiltration into the channel bed. (Baker-FRC)
W82-06852

CONSUMPTIVE USE OF WATER BY MAJOR CROPS IN THE SOUTHWESTERN UNITED STATES,
Science and Education Administration, Phoenix, AR. Water Conservation Lab.
L. J. Erie, O. F. French, D. A. Bucks, and K. Harris.
Conservation Research Report No 29, May 1982. 42 p, 11 Ref, 2 Append.

Descriptors: *Consumptive use, *Irrigation requirements, *Evapotranspiration, *Soil water, *Agriculture, Crop production, Water use, Water management, *Arizona, *Southwest U.S.

Water is a limiting factor in the expansion of irrigated areas and in the production of food for all Western States. Knowledge of consumptive use is necessary in planning farm irrigation and drainage systems, for improving irrigation practices, conserving energy, and assisting in irrigation scheduling. Consumptive use data are presented for 33 cash, oil, hay, bermuda lawn, small grain, forage, fruit, vegetable, and green manure crops as grown in central Arizona. Estimates of seasonal use, semimonthly use, and soil profile moisture depletion are included. Peak-use rates may be estimated from the consumptive use curves. Tentative irrigation schedules can be calculated directly from the consumptive use curves. Data from the figures can be used for irrigation scheduling in areas having growing seasons comparable to those in the Salt River Valley of Arizona. The seasonal consumptive use totals and peak consumptive use rates can be used for planning irrigation projects or farm irrigation systems. A simple method of utilizing this information in different but somewhat similar areas is the Blaney-Criddle formula. The main advantage of this method is that only temperature and sunshine hours are required. (Moore-SRC)
W82-06964

SOME CHARACTERISTICS OF CALCULATING THE WATER REQUIREMENT WHEN DESIGNING IRRIGATION MEASURES,
All-Union Scientific Research Inst. of Water Management Economics and Administration, Moscow (USSR).
T. F. Sokolovskaya, and G. A. Mitrofanov.
Water Resources, Vol 8, No 4, p 355-365, July/August, 1981. 4 Fig, 5 Tab, 12 Ref. Translated from Vodnye Resursy, No 4, p 48-59, July/August, 1981.

Descriptors: *Irrigation design, *Water transfer, *Water requirements, *Irrigation requirements, *Irrigation efficiency, Water conveyance, Probability distribution, Climatic zones, Crop rotation, Water management, Water deficit, Water supply, Seasonal variations, Winter wheat, Grain crops, *USSR.

Irrigation requirements are determined using the concept of asynchronism on fluctuation in the water requirement deficity of irrigated crops. This information allows efficient water transfer among basins, knowing climatic conditions at a particular weather station, the nature of the crops, and the probability percentage of the water requirement deficit. The method considers the probabilities of maximum mean daily water requirement deficits in 10-day periods, instead of assuming that the soil becomes increasingly and uniformly drier as the season progresses. The most efficient of 13 crop rotations may be chosen to manipulate the asynchronism artificially so as to gain the most efficient use of irrigation water. For example, in one climatic zone winter wheat requires the most water between the last third of March and the end of April. Decreasing the proportion of winter wheat in favor of alfalfa, spring wheat, or grain corn can shift maximum water requirements to other periods of the growing season. (Cassar-FRC)
W82-06984

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,
Kansas State Univ. Manhattan. Dept. of Geography.

For primary bibliographic entry see Field 7B.
W82-06994

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05918

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 3F.
W82-05924

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243494, Price codes: A03 in paper copy, A01 in microfiche. Report, August 1981. 42 p, 5 Fig, 7 Ref. OWRT A-071-IDA(1). 14-34-001-0114.

Descriptors: *Model testing, *Rivers, *Prediction, *Runoff forecasting, Model studies, River regulations, River basin development, River forecasting, Projections, Planning, Operating policies, Runoff, Forecasting, Streamflow, Reservoir stages, Water demand, Watersheds, *Idaho, *Upper Snake River, *Boise River.

Update planning models and procedures used by seven operational agencies in two Idaho river basins were investigated. These models and procedures were developed and updated to both improve accuracy and meet changing conditions by public agencies and private companies in the area. Each model and procedure has different objectives, in accordance with the intended purposes of each organization. While most of the models and procedures are computerized, some are still operated manually and most have no published references. They are used to predict runoff (from snow pack data), natural stream flows (from various hydrologic data), and reservoir levels, as well as to account for water diversions from rivers and to evaluate the effects of future demands on surface/ground water in a hydrologic basin. River operations and planning procedures depend on the ability to predict various parameters; however, while accurate streamflow prediction has received considerable attention, it is one of the weakest links in many of the predictive and modeling procedures. The results of this investigation are presented in the form of a narrative summary of the information collected from each organization using a prescribed outline format covering organizational objectives, descriptions of the models and procedures used, and evaluations by the organization. (Zielinski-MAXIMA)
W82-05925

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05926

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 6F.
W82-05930

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 2I.
W82-05967

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,
Nairobi Univ. (Kenya). Inst. for Development Studies.
For primary bibliographic entry see Field 6E.
W82-05987

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
S. Engel.
Report, April 1982. 33 p 9 Fig 3Tab 17 Ref.

Descriptors: *Lake basins, *Macrophytes, *Sediment control, *Algal control, Algal growth, Bottom sediments, Lake restoration, Biomass, Screens, Lake ice, Gravel, Vegetation.

Sediment blankets have been used to seal basins against seepage and groundwater pollution, but they might also be useful for plant control. Three types of sediment blankets (plastic liners, Bidim, Typar) and a polyvinyl-coated fiberglass screen (Aquascreen) were tested for their ability to control submersed macrophytes in two Wisconsin lakes. Conventional plastic liners, covered by sand or gravel to anchor them were densely overgrown when sampled 3, 4, and 7 years later. Bidim and Typar Blankets were covered with pea gravel, placed on one lake's ice cover and allowed to melt through. At other sites they were placed directly on the lake bottom and anchored with bricks. Bidim and Typar blankets are light and gas gets trapped beneath them, so it was difficult to keep them on the lake bottom. Algae and macrophytes took only a year to spread over the blankets. The plants grew just as well on gravel-covered blankets as on those without gravel. Because new Blankets must be added every few years, they have limited use for rehabilitating lakes. Aquascreen was easier to handle, trapped less gas, prevented macrophyte growth in spring, and eliminated growing plants in summer. A few stems penetrated the screen's mesh, but most plants grew on pockets of sediment. Relocating the screens in summer and removing them in the fall prevented sediments from accumulating. Aquascreen can be effective in temporarily suppressing macrophytes in limited areas of lakes. They can be set on the lake bottom or directly over the plants at any time in spring or summer. Aquascreen may be a practical, economical, and environmentally sound alternative to more traditional lake rehabilitation strategies. (Atkins-Omniplan)
W82-06097

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, W. A. Hall, and J. D. Salas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254996, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 111, September 1981. 32 p, 12 Ref. OWRT B-195-COLO(6), 14-34-0001-9060.

Descriptors: *Reservoir storage, *Mathematical equations, *Operating policies, *Reservoir operation, *Optimum development plans, Water storage, Storage tanks, Balancing reservoirs, Reservoirs, Equalizing reservoirs, Mathematical studies, Flood-control storage, Flood control, Planning, Design criteria.

Research was carried out toward assistig water authorities in determinig optimal operatig policies for reservoir systems. This research sought, amont other factors, to develop a methodology (including policy criteria, principles, techniques) for designing the objective functions for planning/operating water storage reservoirs, and to introduce a time factor into the objective functions to represent their continuous evolution. Based on these results, changes are recommended in defining criteria for optimal state reservoirs. Conceptualization of an equivalent reservoir (as an alternative to multireservoir operational schemes/algorithms) was also accomplished. Assessment of the anticipated decision influence period (ADIP) and risk quantification indicated promising approaches; the use of ADIP to develop indices of operational decisions on risks avoidance and operational benefits is theoretically treated employing mass balance equations for discrete time periods (considering inflow, demand, evaporation loss, seepage, spill loss). Further risk formulated rules gave considerable improvement over normal operations for small reservoirs, with even greater improvement for large reservoirs. The use of ADIP in flood operational policies is also considered. (Zielinski-MAXIMA)
W82-06175

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
S. B. Jones.
Proceedings of the Institution of Civil Engineers. Part 2, Research and Theory, Vol 71, No 3, p 759-772, September, 1982. 6 Fig, 17 Ref.

Descriptors: *Flood routing, *Model studies, Routing, Floods, Flood control, Flood forecasting, Flood flow, *Muskingum-Cunge Model, Mathematical models, Mathematical equations.

Hydraulic and hydrologic problems frequently require techniques for modeling the propagation of flood waves along river channels and sewer pipes. The basic equations for gradually varying, unsteady flow in an open channel of small bed slope are the St. Venant equations; these have no analytical solutions, but several numerical techniques have been proposed to solve them, including the method of characteristics and implicit or explicity finite-difference schemes. An example of the last-named type of approach is the explicit variable parameter Muskingum-Cunge method. A modification of this method is presented in which the space and time increments can be chosen objectively to take into account the observed fact that the solution to the convection-diffusion parameter must be selected, depending on channel morphology. Values of the space step and the time step may be selected according to one of three approaches, depending on whether or not one of them is more clearly defined by the physical model under consideration. (Baker-FRC)
W82-06227

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,
Ecole Nationale des Ponts et Chaussees, Paris (France).
J. M. Gaillard, and J. A. Mawdsley.
Hydrological Sciences Bulletin, Vol 27, No 2, p 159-171, June, 1982. 1 Fig, 7 Tab, 22 Ref.

Descriptors: *Reservoirs, *Estimating, Water supply, *Yield, Flow discharge, Water resources development, Error analysis, Errors, Europe.

The error of the estimate of the yield of a direct supply reservoir due to limited data was investigated for conditions prevailing in the northwest of Europe using the errors of the 2% design drought for durations up to 36 months as a measure of this error. Two methods of estimating the 2% drought were considered. First, the monthly design

drought, and second, an empirical procedure which required only rainfall data were the two measures employed. The expected errors for both the direct estimation and the empirical methods are a function of the flow variability of the data records chosen. Since the records used are thought to be representative of European runoff, the comments made are valid only for this region. Other regions with similar flow variability may be able to use these findings. The errors for the design drought were found by splitting a 500 year monthly flow record into shorter records. The 500 year record was obtained by extending an historic record of 111 years using the Thomas Fiering model. To estimate errors of the empirical procedure, the widely used method of Law, which uses rainfall data and the mean annual losses to estimate the design drought, was applied to 13 catchments with historic records greater than 30 years. The error of the empirical procedure was found from the differences between the empirical procedure and the estimate from the historic data. When the results from the two analyses were compared, the accuracy of the empirical procedure for all durations was equal to the accuracy obtained from a record of between 10 and 20 years. (Baker-FRC)
W82-06300

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.
Soil Conservation Service, Boise, ID.
For primary bibliographic entry see Field 6G.
W82-06409

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 419-441, March, 1982. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Streamflow, *Stochastic process, *Mathematical models, Comparison studies, Monthly distribution.

Models which have been developed to generate monthly flows for use in the design and operation of water resources systems can be broadly classified as monthly flow models or as disaggregation processes. The monthly flow models use an autoregressive model for the generation of monthly flows. The disaggregation models distribute annual flows generated by an annual model into monthly flows. A review of variations of these models is followed by a comparison of three monthly models: the Thomas-Fiering monthly model, which automatically takes seasonal variations into acount in the generating equation; the two-tier model, in which monthly flows generated by a Thomas-Fiering monthly model are adjusted against the annual flows generated by an appropriate annual model; and the method of fragments, which is a disaggregation process in which the observed monthly flows are first standardized year by year, followed by disaggregation of the annual flows obtained from any of the annual models into monthly flows using the sets of standardized monthly flows in each year selected at random. Application of these three models to several streams in Australia showed that the Thomas-Fiering monthly model preserved the seasonal monthly parameters for all the streams, although it gave smaller storage estimates than the historical values. The two-tier model and the method of fragments gave improved storage estimates and preserved the annual parameters. All the models gave similar results for the overall parameters for less variable streams, although the modified two-tier model preserved the seasonal monthly parameters better than the other models. It is suggested that a modified two-tier model be used for less variable streams. The method of fragments is recommended for use with highly variable streams, since it yielded smaller values for skewness than the modified two-tier model for these streams, even though it did not preserve the seasonal monthly parameters as well as the two-tier model. (Carroll-FRC)
W82-06427

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,
Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
For primary bibliographic entry see Field 6G.
W82-06429

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
K. C. Gilbert, and R. M. Shane.
Journal of the Water Resources Planning and Managemet Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 21-36, March, 1982. 1 Fig, 38 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

The hydro system simulation (HYDROSIM) model has been developed by the Tennessee Valley Authority to model long-term week-to-week variations in water level, discharge and electric power generation for its complex reservoir system. The basic optimization step in the HYDROSIM model determines optimal end-of-week storage for individual reservoirs, given beginning-of-week storage and weekly unregulated inflows. Scheduling of the 42-reservoir system poses a stochastic, nonlinear, multireservoir problem with both nonviolable physical constraints and violable operating constraints. An 'observe flow then determine release' stochastic formulation is used to simulate operation for 1 to 20 weeks into the future using historical flow sequences. A system of preemptive priority operating constraints is implemented using separable linear programming with upper bounding. A nonlinear power cost function is then minimized subject to the system of priority constraints. The search procedure involves solution of a sequence of linear programs in order to solve the nonlinear optimization problem. (Carroll-FRC)
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
R. M. Shane, and K. C. Gilbert.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 1-19, March, 1982. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, *Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

Computer programs and mathematical methods have been developed to model long-term week-to-week variations in water level, discharge, annd electric power generation for the complex reservoir system operated by the Tennessee Valley Authority. The model has been developed for use in day-to-day planning for operation of the 42 reservoirs and for policy and project studies. The models were intended to meet the need for more efficient use of historical data, better evaluation of new operating requirements, improved long-range guidance, and integration of weather forecasts with guides for operations planning. The hydro system simulation model has been designed to be used by TVA reservoir management personnel to evaluate the impact of new operating requirements on established objectives; to continually check the current reservoir system status to warn of possible future problems; to forecast reservoir operation in terms of possible and likely pool level and discharge variations, constraint violations, and generation characteristics expected in the next 1 to 52 weeks of operation, and to develop new long-range operating guides. The model includes the capability to observe important system operating constraints and priorities; extreme event analysis capability; a special linear programming structure which provides the flexibility necessary to modify operating objectives and to experiment with new types of long-range efficiency guides; and interactive CRT graphical output analysis. (Carroll-FRC)
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
O. J. Helweg, R. W. Hinks, and D. T. Ford.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 169-179, June, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Reservoir operation, *Optimization, *Model studies, Systems analysis, Central Valley Project, California, Tennessee Valley Authority, Drought, Multipurpose projects, Hydroelectric plants, Computers, Data processing.

Optimixzation models for reservoir operation, available for over a decade, are not used at present by any major reservoir system or real time operation. Model development and implementation experiences at representative systems, the Central Valley Project in California and the Tennessee Vally Authority, were examined. At the Central Valley Project a pilot study begun in 1965 led to a series of investigations designed to improve the applicability of optimization techniques to a real-life situation. Monthly and daily models were developed. A complicated hourly model was in the development stage when severe drougnt hit California in 1976. The models were unable to handle the related data inputs. Modifications to the model, made without help from the model builder, produced an inconvenient and unmanageable model. After the drought, work on omptimization models was discontinued. It was estimated that the use of optimization models would produce a benefit-cost ratio of over 17. Computers were first used in the 34 reservoir Tennessee Valley Authority system in 1951. In 1971 an effort to develop models to aid in choosing optimal operations strategies began. At present progress has attained the model validation stage. As of late 1979 no optimization models had been implemented. Basic problems identified in this investigation were lack of upper management support, lack of well qualified and interested personnel involved in the modeling effort, inadequacies of the models (inflexibility, large data requirements, unrealism), and chance occurrences such as the drought, personnel changes, and computer system incompatibilities. The author feels that these problems are all solvable and that adoption of optimization models would substantially increase savings for reservoir operations. (Cassar-FRC)
W82-06433

COMPARING URBAN RUNOFF MODELS,
For primary bibliographic entry see Field 2A.
W82-06447

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06631

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 6B.
W82-06696

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,
George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
For primary bibliographic entry see Field 6B.
W82-06704

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 2E.
W82-06717

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
W. Wahliss, and L. A. Siegerstetter.
Wasserwirtschaft, Vol 72, No 1, p 12-17, 1982. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Multivariate analysis, *Regression analysis, *Time series analysis, *Stream discharge, *West Germany, Danube river, Main river, Diversion, Mathematical models, Projections, Statistical analysis, Flow discharge, Hydrologic systems, Hydrologic models.

An autoregressive multivariate multilag model is presented with which hydrologic time series that are correlated along both the time and space axes can be simulated. Stepwise linear regression is used to determine the regression coefficients. This method establishes a relationship between a goal value and several influencing values that only contains significant regressors. Raw data obtained through the model must be transformed into the normal distribution and standardized before the model can be analyzed. The model was applied to a hydrological system for diverting water from the Altmuhl and Danube rivers to the Regnitz-Main region in West Germany. The system consists of three reservoirs and the natural and manmade channels that connect them. Streamflow was simulated with an autoregressive process with a power of three in eight of the system's water gages. Data collected over a period of 47 years were used to simulate weekly flow. For transformation of the data into the normal distribution, the logarithmic method was best (used in 64% of cases), followed by the Pearson-III function (about 30%). In 100-year series the results showed large chance fluctuations, which was not true of 500-year series. A slight tendency to the overestimation of correlations was seen with increasing lag. The model may also be used to generate monthly and 10-yearly streamflow. (Gish-FRC)
W82-06826

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
A. H. M. Gorgens, and D. A. Hughes.
South African Journal of Science, Vol 78, No 2, p 58-68, February, 1982. 8 Fig, 7 Tab, 28 Ref.

Descriptors: *Semiarid lands, *Streamflow, Hydrology, Arid lands, Semiarid climates, Karoo Biome, *South Africa, Statistical models, Water resources development.

An overview of the extant streamflow monitoring network and available relevant publications concerning the Karoo Biome is presented, along with an analysis of the statistical characteristics of annual and monthly streamflow volumes, low-flow phenomena and flood peaks of a representative set of river basins. Comparisons with other studies and the streamflow characteristics of other climatic zones are also drawn. Implications are discussed for the proper assessment of the surface water resources potential of the Karoo Biome. Such an assessment would be seriously constrained by the twin problems of the poor spatial distribution of reliable streamflow-gauging stations and the paucity of streamflow records of long duration and acceptable quality. A technique that may ease these constraints is that of deterministic rainfall-runoff modeling. The generation of synthetic streamflow records for assessments of water resources potential is also possible by means of stochastic time series modeling, albeit restricted to gauged catchments. The erratic nature of runoff, poor natural carry-over storage, and the low runoff proportions from rainfall in the Karoo catchments may be seen as end effects of a rather tenuous hydrological equilibrium. The response of these catchments to rainfall is likely to be very sensitive to changes induced by land use and management. This hydrological sensitivity underlies the fragile nature of all semi-arid ecosystems and may manifest itself in changes in runoff quality as well as quantity. (Baker-FRC)
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,
Massachusetts Inst. of Tech., Cambridge.
K. P. Georgakakos, and R. L. Bras.
Water Resources Research, Vol 18, No 3, p 513-524, June, 1982. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Model studies, *Flood routing, Bird Creek Basin, *Oklahoma, Routing, Floods, Flood control, Statistical models.

A linearization scheme was developed that makes it possible to use nonlinear routers in an accurate and effective way within the realm of the common linear estimation techniques. The technique also offers the advantage of simultaneous automatic parameter estimation in a simple manner. The Bird Creek example is included to show the feasibility of actual implementation and the effectiveness of the technique. It was concluded that nonlinear routing improves the behavior of the National Weather Service (NWS) model with a linear router. The adaptive nonlinear router is an improvement over its own off-line behavior. Statistical linearization in conjunction with the Taylor Gauss methodology is a powerful tool of analysis for the flood forecasting problem. The conceptual nonlinear flood routing model used can reproduce most of the characteristics of observed output hydrographs, while it does not require high quality input data for the determination of initial parameter values. The automatic parameter estimation scheme is effective and shows promising convergence properties. The use of the model for different flood events in different catchments would increase its credibility. (Baker-FRC)
W82-06855

COMPUTATION OF RUNOFF REDUCTION CAUSED BY FARM PONDS,
Science and Education Administration, Chickasha, OK. Southern Plains Watershed and Water Quality Lab.
R. R. Schoof, and G. A. Gander.
Water Resources Bulletin, Vol 18, No 3, p 529-532, June, 1982. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Runoff, *Ponds, Water storage, Mathematical models, Data collection, Agricultural runoff, Rainfall-runoff relationships, Rainfall, Watersheds, Surface water, Surface runoff, Farm ponds.

A simple accounting method is given for relating the runoff contributing area of watersheds to an index of water in farm pond storage. The procedure was tested on three watersheds. The farm pond storage index, FPSI, could be used with any surface water runoff model on watersheds with several farm ponds and reasonably linear distribution of storage capacity among the ponds. A daily accounting of water stored in all the farm ponds on a watershed was made by daily adjustment of the FPSI, which is defined as the number of inches of watershed runoff stored in the pond that had the largest storage per unit of its drainage area. Rainfall and evapotranspiration computed by a Jensen-Haise equation were input to the model. A linear relationship was assumed between the storage index and the portion of the controlled drainage area that was contributing to runoff. Adjusting the computed runoff with the FPSI reduced the coefficient of variation of monthly measured versus computed surface runoff for each of the three watersheds. The correlation coefficients for the same comparisons were increased. The annual predicted surface runoff was improved for 12 of the 17 station years of data tested. A test of the significance of the improved simulation using the FPSI indicated at the 95% confidence level that there was some improvement. The farm pond storage index could be used with any surface runoff model to improve the prediction of runoff from watersheds with drainage areas greater than 1 square mile and with about 20% or more of the drainage area controlled by farm ponds. (Baker-FRC)
W82-06874

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,
Kinnert Limnology Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W82-06879

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,
Geological Survey, Sacramento, Calif. Water Resources Division.
J. C. Blodgett.
Open-File Report 81-1010, March 1982. 32 p, 11 Fig, 11 Tab, 8 Ref.

Descriptors: *Flood flow, *Streamflow, *Flow characteristics, *Bridges, Levees, Channel morphology, Flow rates, Discharge measurements, Flood profiles, Agriculture, Flood plains, Flood data, *California, Honcut Creek.

State Highway 70 crosses Honcut Creek about 3.2 miles upstream from its confluence with the Feather River, by three bridges separated by short approach embankments. The California Department of Transportation is planning to replace or widen these bridges; this report evaluates flow characteristics of the existing and proposed crossings. Agricultural improvements on the flood plain and low levees affect the magnitufe and distribution of flow to the bridges. Water-surface elevations of Honcut Creek are affected by levees on the flood plain, a natural channel constriction about 3,000 feet downstream from the bridges, and by high water levels on the Feather River. The average recurrence interval for overbank flow is less than 2 years. A flood with an average recurrence interval of 50 years would be about 19,000 cubic feet per second. For flows of 20,000 cubic feet per second on Honcut Creek, and with present bridge conditions, backwater caused by the bridge is about 0.4 foot. If the left-bank bridge is eliminated, backwater would increase to 0.5 foot. The bridges and approach embankments occupy about 66 percent of the channel. The average velocity of flow at the bridge ranges from 1 to 3.2 feet per second. For present channel and bridge conditions, overbank flows are distributed among the three bridges in a proportion of about 10, 40, and 50 percent for flows between 2,850 and 8,480 cubic feet per second. (USGS)
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,
Geological Survey, Denver, Colo. Water Resources Division.
For primary bibliographic entry see Field 2E.
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and E. E. Webber.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.25, Microfiche $4.50. Open-File Report 81-414, 1981. 7 p, 2 Fig, 5 Ref.

Descriptors: *Floods, *Flood flow, *Flood discharge, *Flood recurrence interval, Flood frequency, Hydrologic data, *Ohio, Gallipolis, Chickamauga Creek basin.

An intense summer rain estimated at 4 to 5 inches in 2.5 hours caused flooding on a Chickamauga Creek tributary 4.5 miles northwest of Gallipolis, Ohio. Computation of a peak discharge of 1,350 cubic feet per second from 3.03 square miles of drainage area (446 cubic feet per second per square mile) indicates a greater-than-100-year flood. (USGS)
W82-06947

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGUOULA, AND TENNESSEE RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06955

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06957

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
For primary bibliographic entry see Field 4C.
W82-06983

4B. Groundwater Management

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 6E.
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05940

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,
Komenskeho Univ., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2F.
W82-05943

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, H. Fabris, D. Thiery, and A. Menjoz.
Water Resources Research, Vol 18, No 2, p 253-265, April, 1982. 11 Fig, 3 Tab, 18 Ref.

Descriptors: *Water storage, Water resources development, *Model studies, *Thermal water, *Injection wells, *Confined aquifers, Resources development, Aquifers, Project planning, Aquifer management, Resources management, Water temperature.

Hot water storage in a single well or in a pair of wells (doublet) in the French Jura was examined in ten successive experiments conducted in 1976-1977 in a confined aquifer 2.5 m thick. Injected volumes ranged from 500 to 1700 cu m, and temperature profiles were taken daily in 12 boreholes distributed along two perpendicular axes within 13 m of the injection well. Individual temperatures were recorded by thermistors placed in the caprock, and results were used to calibrate two mathematical models. An axisymmetric model allows the calibration of average values of the parameters, while a three-dimensional model determines their spatial variation in the horizontal plane and identifies a nonhomogeneous transmissibility field for both hydraulic and thermal contour curves. The water content of the caprock and the thermal dispersion in the aquifer proved important to the recovery ratio. Use of the model in Auburn showed adequate predictions of water temperature during the production phases. (Geiger-FRC)
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, A. C. Menjoz, and P. A. Landel.
Water Resources Research, Vol 18, No 2, p 245-252, April, 1982. 7 Fig, 4 Tab, 14 Ref.

Descriptors: Water resources development, *Project planning, *Water storage, *Mathematical models, *Injection wells, *Economic aspects, *Aquifer management, Resources development, Geothermal resources, Planning, Aquifers, Model studies, Thermal water, Heated water, Groundwater storage.

A general study was undertaken to assess the economic feasibility of aquifer heat storage projects using a single well. A mathematical model shows that storage efficiency and temperature are influenced by a limited number of dimensionless groups that are controlled by the aquifer's physical properties and its storage operating characteristics. A numerical model is compared with analytical solutions before being used to evaluate the variation with time of the well temperture when production volume and flow rate are equal to the injection volume and flow rate. These results are utilized to plot type curves for several sets of dimensionless parameters covering a range of practical applications. Suggestions are made for efficient storage projects, and the effects of unequal injection, production periods, standby periods, and other conditions of operation are also examined. (Geiger-FRC)
W82-06059

DAILY OPERATIONAL TOOL FOR MAXIMUM BENEFICIAL USE MANAGEMENT OF SURFACE AND GROUND WATERS IN A BASIN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, K. L. Verdin, and T. H. Illangasekare.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254988, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 112, March 1982. 39 p, 18 Fig, 2 Tab, 7 Ref. OWRT B-199-COLO(4), 14-34-0001-9109.

Descriptors: Hydrologic models, *Geohydrology, *Surface water, *Surface-groundwater relations, *Water management, *Basins, Management planning, Numerical analysis, Computer models, Model studies, Hydrologic systems, Hydrologic data, Hydrologic equation, Hydrologic systems, Hydrologic aspects, Hydrologic budget, Groundwater budger, Groundwater, Mathematical studies, Subsurface water.

A developed two-dimensional groundwater hydrologic model, based on numerical-analytical procedure, is preseted and tested. This model incorporates, the discrete kernel modeling approach, a scanning sub-system and sequential reinitialization. Further, it possesses an ability to compute drawdowns at particular locations rather than only average values over cells to provide new input to standard modeling approaches. The model was tested for accuracy and economy. It was found that it consistently will provide results of at least comparable accuracy to that attained with standard finite difference techniques, provided that its variables are properly selected. In addition, the developed model, in certain cases, provides solutions closer to the true solution. The model can also generate solutions with comparable accuracy at reduced cost relative to other computer models, provided that judicious selection of the model's input for sub-system size and reinitialization period is made. The model is particularly efficient if more than one simulation run is to be made on the same system. Appropriate use of the model should substantially reduce the cost of management studies on conjunctive use of surface water and groundwater. (Zielinski-MAXIMA)
W82-06174

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,
Windrem, Feeney and Williams, Lakeport, CA.
For primary bibliographic entry see Field 6G.
W82-06217

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,
O'Melveny and Myers, Los Angeles, CA.
For primary bibliographic entry see Field 6E.
W82-06218

DESIGN OF HEAT PUMP RETURN WELLS,
Michigan Dept. of Public Health, Lansing.
For primary bibliographic entry see Field 8C.
W82-06294

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06303

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
S. Snipes.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256553, Price codes: A06 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson, Publication No 93, June 1981. 87 p, 18 Fig, 9 Tab, 40 Ref, 8 Append. OWRT A-047-SC(1).

Descriptors: Water quantity, Water quality, *Lineaments, *Fracture traces, *Fracture zones, Joints, Faults, *Metamorphic rocks, Drilled wells, Bored wells, Hand dug wells, Springs, *South Carolina, Piedmont, *Chemical analysis, Coliform bacteria, Pollutant identification, *Water wells.

More than 200 water well locations have been plotted in Anderson and Oconee Counties in the Piedmont of northwestern South Carolina. The coherent rocks of this metamorphic terrain are virtually impermeable and the median yield of water wells randomly situated in them is only 4 gpm. Moreover, the risk of a dry hole in such wells is 1 in 4. In contrast, water wells situated in fracture zones have a median yield of 20 gpm while the probability of a dry hole is 1 in 71. Nearly all of the wells with yields of greater than 50 gpm are situated in fracture zones and yields of more than 400 gpm have been reported. Aerial photographs and topogrphic maps were analyzed to locate fracture traces and lineaments. Field studies have shown that most of them are attributed to vertically dipping systematic joints or fault zones. More than 400 linear features have been mapped; 43 of them are fault zones, while most of the remainder are attributed to systematic joints. Fifty-eight ground water samples were analyzed for their chemical properties and 48 samples were analyzed for their content of coliform bacteria. Most of the ground water samples had good to excellent chemical properties. Twenty-four percent of the rural, shallow, hand dug wells had fecal contamination and 1 of the 8 spring samples showed fecal contamination. The drilled and bored wells contained very little bacteria and no fecal contamination. (Author abstract)
W82-06309

A TWO-DIMENSIONAL, FINITE ELEMENT MODEL OF SALT WATER INTRUSION IN GROUNDWATER SYSTEMS,
Guam Univ., Agana. Water Research Inst. of the Western Pacific.
D. N. Contractor.
Technical Report No 26, October 1981. 64 p, 9 Fig, 16 Ref, 4 Append.

Descriptors: *Model studies, *Saline-freshwater interfaces, *Saline water intrusion, *Aquifers, Coastal waters, Water boundary, Groundwater movement, Flow rates, Computer programs, Fortran.

Careful management of aquifers with coastal boundaries is essential to guard against excessive salinity concentrations. Management includes knowing the location of the saltwater under present and future pumping conditions. A numerical model can help estimate the location of the saltwater for given sets of hydraulic conditions. This report describes the development and use of a sharp interface model to simulate salt-water intrusion into coastal and insular groundwater aquifers. The model, using linear triangular elements, can simulate steady or unsteady conditions in confined or unconfined aquifers. Three types of boundary conditions can be specified: head as a function of time; flow as a function of time; and a mixed boundary condition for freshwater flowing into a coastal boundary. Freshwater wells can be located at any node. Freshwater and saltwater toes can be tracked with time, and the direction and velocity in each element can be identified. In addition, aquifers containing only freshwater can be simulated by specifying the saltwater head at all nodes to be much less than expected freshwater heads. The model has been used to simulate several natural aquifers, with complex boundaries, and varied basement topography and boundary conditions. The results were compared with analytic solutions and, in all cases, the comparisons were good. The availability of such a model enables the manager of an aquifer to explore the advantages and disadvantages of various options relating to the development of the resource. The computer program has been written in FORTRAN. (Atkins-Omniplan)
W82-06525

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,
Youngstown State Univ., OH Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-06584

AN OPTIMIZATION ALGORITHM IN A SYSTEM FOR MANAGEMENT OF THE REGIONAL SAFE GROUNDWATER YIELD,
Moscow State Univ. (USSR). Inst. of Mechanics Research.
E. V. Guseva.
Water Resources, Vol 8, No 3, p 329-336, May/June, 1981. 1 Fig, 3 Tab, 3 Ref. Translated from Vodnye Resursy, No 3, p 167-175, May/June, 1981.

Descriptors: *Safe yield, *Aquifer management, Groundwater management, Seepage, Numerical analysis, Model studies, Suzak Basin, *USSR, Optimization, Geohydrology, Wells, Mathematical models, Hydrodynamics.

A linear problem for conditions of confined seepage was examined. The numerical calculations of the prediction of cones of depression for a period up to 30 years were done using data from the Suzak artesian basin in Central Asia. The objective was to obtain the maximum possible amount of water in a given region with prescribed restrictions on the decline of the water table. Two variants of the problem were considered: (1) locations of the water intakes were fixed, and (2) the locations of the water intakes were unknown and to be determined. The method was satisfactory for managing safe regional yields. (Cassar-FRC)
W82-06616

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6B.
W82-06694

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
For primary bibliographic entry see Field 6B.
W82-06700

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,
Novosibirsk State Univ. (USSR).
For primary bibliographic entry see Field 7C.
W82-06784

WHO OWNS NEBRASKA'S GROUND WATER,
Nebraska Univ. Lincoln.
For primary bibliographic entry see Field 6E.
W82-06819

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-06831

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-06949

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-06950

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
H. T. Buxton, J. Soren, A. Posner, and P. K. Shernoff.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $8.25 Microfiche $3.50. Open-File Report 81-1186, 1981. 59 p, 28 Fig, 2 Tab, 25 Ref.

Descriptors: *Groundwater, *Water quality, *Groundwater potential, *Water supply, Water management, Available water, Urban hydrology, Water use, Saline water intrusion, Contamination, Aquifer characteristics, Wells, Water level, Chemical anlaysis, *New York, *Long Island, Kings County, Queens County.

Western Long Island's ground-water resources are being considered for redevelopment as a supplemental source of public water supply. The groundwater reservoir in Kings and Queens Counties had supplied an average of more than 120 million gallons per day for industrial and public water supply from 1904 to 1947. However, deterioration of groundwater quality from induced encroachment of salty ground-water caused the total cessation of pumping for public supply in Kings County in 1947 and in western Queens County in 1974. This investigation was designed to make a preliminary evaluation of the present groundwater quality and to review hydrologic information pertinent to the formulation of an appropriate development plan. Detailed hydrogeologic mapping was done to define the geometry of the ground-water system. The history of ground-water development and the consequent responses of ground-water levels and quantity were summarized. A well network was established to monitor ground-water levels and ground-water quality in Kings and Queens Counties. The distribution of chloride and nitrate in ground-water was used to identify contamination from salt-water intrusion and surface sources. A limited source of potable ground-water is available in the Magothy-Jameco and Lloyd aquifers; however, an accurate estimate of the quantity of water available or a draft rate suitable for maintaining a useable ground-water quality is undetermined. (USGS)
W82-06952

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06956

4C. Effects On Water Of Man's Non-Water Activities

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W82-06096

URBAN CREEKSIDE DESIGN FEATURES PARALLEL STREETS,
Santa Clara Valley Water District, CA.
L. C. Fowler, and S. N. Wolfe.
Civil Engineering (New York), Vol 52, No 6, p 72-74, June, 1982. 3 Fig.

Descriptors: *Flood control, *Community development, *Urban planning, Construction, Design criteria, *Land use planning, Parallel streets.

Proper land use restraints and creative design can be used to prevent flooding and preserve the natural wildlife habitat which forms along a waterway, even in an urban setting. Streets parallel to waterways in developed areas separate the streams from neighboring houses, emphasizing open space and providing neighborhood privacy and security. Communities benefit more if creeks and channels are kept in the open where the public can see and use them. Maintenance is easier because of convenient access, and minor erosion or silt deposition does not create an immediate hazard to adjoining property. The design of parallel streets reduces the number of bridges required along the channels, thus reducing total cost to the community. Variations in the pattern of streets on both sides of and parallel to creeks can be made by looping streets or using dead-end streets, which reach to the creek margins. In valleys where the stream channel is located on higher elevations, levees are needed along the banks of the stream to contain the floodwaters. By setting the levees back away from the actual stream channels, the natural corridor is maintained and the carrying capacity enlarged to reduce the flood potential to the urban areas adjacent to the streams. (Baker-FRC)
W82-06184

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2J.
W82-06336

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,
CH2M Hill, Bellevue, WA.
For primary bibliographic entry see Field 2J.
W82-06553

FIRST-YEAR EFFECTS OF CLEARCUTTING AN OAK-HICKORY WATERSHED ON WATER YIELD,
Illinois Univ. at Urbana, Champaign. Dept. of Forestry.
R. J. Brozka, G. L. Rolfe, and L. E. Arnold.
Water Resources Bulletin, Vol 18, No 1, p 139-145, February, 1982. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Water yield, *Forest watersheds, *Clear-cutting, Forest management, Forest hydrology, Water quality, Nutrients, *Illinois.

Although water has always been a dominant consideration in forest management objectives, it is only recently that the effects of forest harvesting on water quality have been investigated intensely. The present study evaluated the effects on water quality of clear-cutting in southern Illinois, where soils are generally shallow, easily eroded, nutrient deficient, and on steep slopes, and where rainfall is relatively heavy. Two intermittent streams on oak-hickory watersheds were gaged with a V-notch weir and sampled with an automatic water sampler. Baseline data collected for 3 years showed large variations in flow volume between years and between watersheds. Analysis of water samples for sodium, potassium, calcium, magnesium, orthophosphorus, and nitrate-nitrogen (NO_3-N) showed that water quality was consistently high, although there were significant differences between the watersheds, there was a 95% increase in flow volume, although there was no evidence of increased sedimentation. Stream water concentrations of potassium, magnesium, and nitrate-nitrogen increased 18%, 8%, and 274% respectively. Nutrient budgets for the site were not adversely affected by the harvest, due largely to the care taken to avoid disturbance to the site during logging, the careful layout of the harvest operation, and the below-normal precipitation the first year following the harvest. These results indicate that clearcuts of moderate size which are carefully planned and carried out should not pose a threat to water quality nor degrade site productivity. (Carroll-FRC)
W82-06589

REDUCTION OF URBAN RUNOFF THROUGH ECONOMIC INCENTIVES: BOULDER, COLORADO,
Colorado Univ., Longmont.
S. A. Thompson.
Water Resources Bulletin, Vol 18, No 1, p 125-127, February, 1982. 4 Ref.

Descriptors: *Urbanization, *Urban runoff, *Runoff volume, *Storm runoff, Economic incentives, Economic aspects, Flood control, Regulations, Boulder, *Colorado.

The process of urbanization results in fundamental alterations of interrelationships within the natural environment. The most obvious of these changes is the increased percentage of precipitation which becomes direct surface runoff as a result of the transformation of the land surface from a permeable to an impermeable covering. In 1974 the city of Boulder, Colorado, adopted storm drainage and flood control fee designed to charge property owners for altering the natural environmental relationships among precipitation, infiltration, and runoff and to encourage these owners to decrease their contributions to surface runoff. Single family residential lots are assessed $1.00 per month. All new developments other than single family lots which are not part of a larger development are required to install on-site detention storage facilities capable of controlling the runoff asssociated with a storm having a 5-year frequency, in return for which they receive a 20% reduction in the normally computed fee. If it provides storage capable capable of controlling runoff from storms with return frequencies of 10, 20, or 100 years, the parcel receives a 40, 60, or 80% reduction in the fee, respectively. Although most new developments have included detention storage facilities exceeding the minimum required, there have been no reports of retrofitting existing developments with such facilities. Also, only three single family residences have installed detention facilities. It is suggested that more could be done to encourage and assist homeowners to install detention facilities and to ensure that owners of existing developments understand the benefits of retrofitting their properties with detention storage. (Carroll-FRC)
W82-06629

EVALUATION OF EFFECTS OF STORM-WATER DETENTION IN URBAN AREAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W82-06698

STREAMFLOW CHANGES AFTER LOGGING 130-YEAR-OLD DOUGLAS FIR IN TWO SMALL WATERSHEDS,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
R. D. Harr, A. Levno, and R. Mersereau.
Water Resources Research, Vol 18, No 3, p 637-644, June, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Watershed management, *Water resources development, Watersheds, Forest watersheds, Logging, *Oregon, Streamflow, *Douglas fir trees.

A case history was prepared of changes in streamflow observed after harvesting in two small experimental watersheds. The study area consists of three small watersheds located between the 865 and 1155 meter elevations on the south aspect of Blue Ridge, the major divide between the Blue River drainage to the north and the Lookout Creek watershed which comprises the H. J. Andrews Experimental Forest. Timber harvest in watersheds containing 130 year old timber increased annual water yield up to 42 cm. For 4 years after logging, yield increases averaged 38 cm at a 13.0 ha clearcut watershed and 20 cm at a 15.4 ha watershed where timber was shelterwood cut. Increased summer flows were indicated by the much smaller number of low-flow days after logging, particularly at the clearcut watershed. During the 1977 drought year, only eight and two low-flow days occurred at the clearcut and shelterwood cut watersheds, respectively, compared to 143 and 135 low-flow days predicted by the calibration relationship. Neither the size nor the timing of peak flows changed significantly after logging at either watershed. (Baker-FRC)
W82-06849

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,
Geological Survey, Orlando, FL.
For primary bibliographic entry see Field 5B.
W82-06877

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,
Maine Cooperative Fishery Research Unit, Orono.
For primary bibliographic entry see Field 5C.
W82-06910

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 5C.
W82-06965

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
V. S. Perekhrest, and S. M. Perekhrest.
Water Resources, Vol 8, No 4, p 365-369, July/August, 1981. 1 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 4, p 60-65, July/August, 1981.

Descriptors: *Land management, *River flow, *Drainage effects, Water management, Runoff, Dnepr River, *USSR, Irrigation effects, Lakes, Reservoirs, Agriculture, Water use, Precipitation, Rainfall-runoff relationships, Economic development, Flow, Environmental effects, Ecological effects.

The Dnepr Basin is an example of several basins in the European SSR which display noticeable changes in river runoff as a result of anthropogenic influences such as irrigation, drainage, construction of reservoirs and ponds, and erosion control. Examination of the chronological variation of precipitation and runoff and the residual mass runoff curves for the Kiev gaging station revealed 3 cycles of variations in discharge volume of the Dnepr. The first period (1881-1919) was characterized by little economic activity in the area except some drainage work. During the second period (1920-1942) runoff was still under nearly natural conditions. Drainage work involved only 350,000 ha out of 6.5 million ha. Some land improvement and erosion control projects begun in the 1930's were interrupted by World War II. In the third period (1943-1971) extensive drainage projects, reservoir construction, forest improvement, and erosion control produced considerable effects, both positive and negative, on river runoff. Annual runoff values corrected for climatic and physiographic factors for the second and third periods were 45.4 and 42.2 cu km, respectively, at the Kiev gaging station and 54.8 and 50.2 cu km, respectively, at the Lotsmanskaya Kamenka gaging station. (Cassar-FRC)
W82-06983

4D. Watershed Protection

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,
Wisconsin Univ.- Madison. Dept. of Geography.
J. C. Knox, S. J. Cary, and F. J. Magilligan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243544, Price codes: A04 in paper copy, A01 in microfiche.

Technical Report WIS WRC 81-03, 1981. 56 p, 19 Fig, 3 Tab, 62 Ref. OWRT A-079-WIS(2). 14-34-0001-8053/9053.

Descriptors: *Sediment yield, *Climatic data, *Seasonal variation, *Model studies, *Watersheds, Sediment transport, Sediment load, Sediment discharge, Sedimentary basins, Precipitation rate, Snowmelt, Environmental effects, Streams, Land use, Time series analysis, Storms, Storm runoff, *Wisconsin, *Black Earth Creek.

Variations in sediment availability were examined to assess the probable impacts of the documented environmental changes for sediment production in upper Balck Earth Creek. Analysis of the monthly sediment transport relationship permitted quantification of seasonal and within-season variations of sediment availability in response to precipitation variations. Sediment availability in the Creek (as indicated by the exponent of the regression equation describing the power functional relationship between sediment and water yields) was high in early summer, and low at other times. Monthly precipitation was negatively associated with sediment availability at all times of the growing season, except for the early spring following snowmelt. A relatively high Creek sediment production in the 1954-60 period was attributed to the frequent occurrence of large storms in late spring/early summer. The relatively low annual sediment production from 1961-65 was attributed to the shift of most large storms to the late summer months. Observed land use changes toward a greater erosion potential were less important than climatic factors for determining annual Creek sediment production between 1954-65. (Zielinski-MAXIMA)
W82-05931

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06151

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
C. T. Osborn, A. D. McQueen, and R. N. Shulstad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254947, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Bulletin 856, November 1981. 23 p, 5 Fig, 4 Tab, 8 Ref. OWRT A-056-ARK(1).

Descriptors: *Cost-benefit analysis, *Soil erosion, *Erosion control, *Watersheds, *Recreation, Cost analysis, Costs, Economic aspects, Recreation facilities, Public waters, Project planning, Forecasting, Bank erosion, Planning, Forecasting, Benefits, *Arkansas, Lake Chichot.

A study was conducted to determine the most cost effective soil erosion control program to maintain current recreational viability for the northern basin of Lake Chicot, and to establish, through benefit-cost analysis, whether such a program could be justified economically. Using mathematical approaches for estimating costs and benefits discretely, it was possible to calculate a benefit-cost ratio (b/c) for a soil erosion control program that would at least maintain the present water quality of the northern Lake basin. With a b/c ratio greater than unity representing a program economically desirable, a ratio of 112 was obtained using the consumer's surplus limiting case benefit over the present value of costs for a project life of 50 years, while a ratio of 81 was obtained using a 20-year planning horizon while retaining all other assumptions. Further, in the worst case, the b/c ratio was found to be 33. Hence, the magnitude of these b/c ratios clearly implies the high desirability of initiating a soil erosion control program from society's standpoint. Recreational benefits are by far the most significant; their preservation is the primary goal of the proposed program. (Zielinski-MAXIMA)
W82-06170

EVALUATION OF THE STREAM REACH INVENTORY AND CHANNEL STABILITY INDEX FOR INSTREAM HABITAT ANALYSIS,
Wyoming Univ., Laramie. Water Resources Research Inst.
W. H. Eifert, and A. Wesche.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256546, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series No 82, May 1982. 106 p, 13 Fig, 15 Tab, 81 Ref, 2 Append. OWRT A-033-WYO(1), 14-34-0001-1154.

Descriptors: *Channel stability, *Aquatic habitat, *Trout, *Ocular survey, Standing crops, *Wyoming, Indicators, Bioindicators, *Correlation analysis, *SRICSI methodology, Montane streams.

In 1975, the Northern Region of the U.S. Forest Service developed an ocular watershed evaluation methodology entitled 'Stream Reach Inventory and Channel Stability Index' (SRICSI). Designed to assess the physical aspects of channel and streamback stability, the SRICSI's value as an aquatic habitat evaluation technique was basically unknown. During the spring and summer of 1981, 17 representative study sites on two 2nd order montane streams were evaluated through application of the SRICSI procedure and three aquatic habitat assessment methodologies. Salmonid population estimates were also obtained for each site. Trout standing crop estimates were statistically compared to study site SRICSI scores, the results obtained from the habitat evaluation procedures, and to data collected on 63 habitat-related independent variables. Results indicate a significant relationship exists between SRICSI scores and both trout population estimates and to two of the three habitat evaluation procedures. All correlations were negative, thereby suggesting that as SRICSI scores increase, trout standing crops and subsequent habitat conditions decreases. Additionally, 40 habitat variables displayed significant correlations to trout standing crop data, with 15 selected for possible inclusion in the SRICSI. Inclusion of those variables found compatible with the SRICSI procedure should increase its biological sensitivity thereby broadening its use in aquatic habitat studies.
W82-06308

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2J.
W82-06364

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,
Army Engineer District, St. Louis, MO.
For primary bibliographic entry see Field 2J.
W82-06426

EROSION CONTROL AT A DELICATE HIGHWAY CONSTRUCTION SITE,
Oregon Dept. of Transportation, Salem.
J. H. Versteeg, and J. J. Earley.
Public Works, Vol 113, No 3, p 82-83, March, 1982.

Descriptors: *Erosion control, *Highway relocation, *Soil erosion, Construction, *Oregon, Dikes, Dams, Mulches, Channel improvement, Fish conservation, Slope stabilization, Landslides, Water quality control, Monitoring, Sediment control.

Reconstruction of a section of Interstate 5 in Oregon included several features designed to prevent adverse environmental effects during construction. To control stream turbidity heavy equipment was kept out to the stream channel as much as possible and stream crossing-sediment traps were constructed. Dikes were built to isolate construction activities from the flowing stream. Straw bales underlaid with drain rock were placed in slope gullies. Seed and straw mulch were put on slopes. Slopes were terraced to reduce soil erosion. Shrubs and willow trees were planted to control erosion and maintain cooler water temperatures. Six potential slides are being monitored so that stabilization may be undertaken if necessary. No work was done in existing streams during October 15 through June 1, so that fish spawning was not disturbed. Sediment dams and straw bale sediment barriers were installed after June 1 and were removed before October 15. Most dams trapped 8-24 inches of mud, which was cleaned out before the fall rains. Water quality, as measured by pH, dissolved oxygen, turbidity, and temperature, was within acceptable limits. Notched weirs were located in 21 sites where stream gradient and water velocity were excessive. (Cassar-FRC)
W82-06510

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
For primary bibliographic entry see Field 2J.
W82-06620

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),
For primary bibliographic entry see Field 8E.
W82-06636

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06672

SUBSURFACE DRAINAGE EFFECTS ON EROSION,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, A. A. Nassehzadeh-Tabrizi, and G. R. Foster.
Journal of Soil and Water Conservation, Vol 37, No 3, p 167-172, May/June, 1982. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Erosion control, *Subsurface drainage, Drainage, Erosion, Groundwater movement, Subsurface drains, Drains, *Model studies, *North Carolina, Goldsboro, Soil types, Sand, Loam, Surface runoff, Simulation analysis.

A computer simulation method for characterizing the effects of artificial drainage on erosion is presented, and the use of this method is demonstrated on a soil in eastern North Carolina. The drainage simulation model, DRAINMOD, was coupled with the CREAMS model for simulation erosion. Use of the coupled model was demonstrated for Goldsboro sandy loam soil. The simulation showed that erosion on Goldsboro soil with an average slope of 2% could be reduced appreciably with subsurface drainage. For example, predicted average annual rates of erosion declined by a factor of 10, from 9 to 0.9 metric tons per hectare, upon changing the drainage system from one with good surface drainage and poor subsurface drainage to one with poor surface drainage and good subsurface drainage. Subsurface drainage, therefore, should be considered as a possible best management practice for reducing erosion on relatively flat land, since it increases available profile storage and reduces surface runoff. On the negative side, intensive subsurface drainage generally increases nitrate loss from agricultural land. Whether increased loss of nitrates counteracts the beneficial effect of reducing sediment and associated nutrient and pesticide losses depends on the site and the quality of the receiving waters. Use of artificial

drainage can significantly affect the rate and flow path of water leaving the field. (Baker-FRC)
W82-06795

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
A. D. McQueen, R. N. Shulstad, and C. T. Osborn.
Journal of Soil and Water Conservation, Vol 37, No 3, p 182-185, May/June, 1982. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Erosion control, *Farm management, *Soil loss, Erosion, North Lake Chicot, *Arkansas, Crops, Watershed management, Cost-benefit analysis, Water Quality, Water pollution effects.

The costs of alternative methods of erosion control in a specific watershed were investigated. The watershed under study was North Lake Chicot, a 5,025 acre oxbow lake created by the past meandering of the Mississippi River. While the lake at one time offered excellent fishing and other recreation, channelization and levee construction in nearby areas diverted drainage and floodwaters from about 350 square miles of agricultural land into Connerly Bayou and ultimately into Lake Chicot. A levee was constructed across the lake just north of the point where Connerly Bayou enters it. The southern basin's impact has been substantial over the ensuing years, but the northern basin remained quite clean and free of significant pollution until recently. Erosion control policies were evaluated using a linear programming model, which incorporated constraints on the amount of field equipment, irrigation equipment, and time available for agricultural production. Seven crop rotations and four management practices were evaluated. The analysis indicated that soil loss could be reduced 24% per year while increasing net revenues by 28% with proper soil management and cropping patterns. Both cover cropping and the use of an average soil loss restriction were more cost effective than the Soil Conservation Service structural plan for reducing soil erosion in the watershed. (Baker-FRC)
W82-06796

EFFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,
Allahabad Univ. (India). Dept. of Chemistry.
S. Chandra, and S. K. De.
Soil Science, Vol 133, No 4, p 228-231, April, 1982. 4 Tab, 13 Ref.

Descriptors: *Manure, *Erosion rates, *Soil stabilization, Fertilizers, *Animal wastes, Farm wastes, *Soil erosion, Erosion control, *India, Cattle, Soil texture, Bacteria, Soil bacteria, Soil amendments, Soil treatment.

Cattle manure was applied at concentrations of 1% and 2% to soils from six sites in India in a laboratory study to determine erosion coefficient at 15 and 30 days incubation. The 1% concentration decomposing for 30 days effectively reduced soil erosion. Erosion coefficients were 68.8-8.1 compared with 82.9-9.6 in untreated soils. The 2% concentration was only slightly better than the 1% concentration. At the 15 day incubation point erosion coefficients were higher than those of untreated soils. This was caused by a temporary increase in C02 and soil pH during decomposition of the manure. Manure application was more effective in light textured soils with higher erosion coefficients. The four treatments were ranked in order of efficiency: 2%, 30 days > or = 1%, 30 days > 1%, 15 days > 2%, 15 days. (Cassar-FRC)
W82-06834

APPLICATION OF SCS INFILTRATION MODEL,
S. Kumar, and S. C. Jain.
Water Resources Bulletin, Vol 18, No 3, p 503-507, June, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Infiltration, *Model studies, Rainfall, Runoff, Hydrology, Flow, Rainfall-runoff relationships, Overland flow.

Application of the Soil Conservation Service (SCS) infiltration model to the watershed of the north branch of Ralston Creek, northeast of Iowa City, Iowa, is considered. The 3.01 square mile watershed is largely rural and agricultural. It has a channel length of four miles and a drop in elevation of about 140 feet. The valley has fairly steep slopes in its southern and eastern sections, with a gently rolling configuration over the western and northwestern parts. The SCS infiltration model was modified to suit the type of rainfall data needed for predicting overland flood hydrographs. Hourly runoff and loss rates were computed using the SCS model. The precipitation in five-minute intervals was superimposed on the hourly loss rate. The hourly loss rates were then adjusted such that the volume of rainfall excess computed using five-minute data agreed with the hourly runoff predicted by the modified SCS model. A trial and error procedure was adopted to determine the curve number, AMC, and MIR for the distributed watershed. The complete distributed watershed model including the modified SCS model was tested for two storms. The results indicate that the infiltration model satisfactorily described the distribution of losses and that the technique of calculating rainfall excess hyetographs to develop overland flood hydrographs is adequate. (Baker-FRC)
W82-06872

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Water Resources Bulletin, Vol 18, No 3, p 415-421, June, 1982. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Model studies, *Sediment discharge, Sedimentation, Sediments, Mathematical studies, Erosion, Dynamics, Watersheds, Small watersheds, *Watershed management.

A dynamic system sediment discharge model based on upland erosion mechanics was developed and tested. The system model was intended to simulate sediment discharge with short time increments using simple hydrologic variables such as rainfall intensity and runoff. This would allow the model to be incorporated into hydrologic models. The model was developed from an expansion of splash and flow erosion relationships under steady state conditions. It incorporated eight parameters such as rainfall intensities, runoff rates, and previous sediment discharges. The model was tested on two small watersheds, with simulation results which were highly satisfactory relative to the data. The resulting linear model explained variations with coefficients of determination averaging 0.99. Parameter coefficients varied with storm characteristics, suggesting that the proposed model is a quasi-linear model. This leads to a conclusion that sediment discharge systems may not be properly represented by any single flow-sediment discharge relationship. The model was also tested with snowmelt events as well as with storm oriented runoff. (Baker-FRC)
W82-06876

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 8B.
W82-06959

FIRE AND GEOMORPHIC PROCESSES,
For primary bibliographic entry see Field 2J.
W82-06963

MANAGEMENT OF WATERSHED REHABILITATION-- REFLECTIONS FROM MT. ST. HELENS AND REDWOOD CREEK,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. J. Swanson, and S. D. Veirs Jr.
In: Proceedings of a Symposium on Watershed Rehabilitation in Redwood National Park and Other Pacific Coastal Areas, August 24-28, 1981, Arcata, California, Center for Natural Resource Studies, Sacramento, California, 1982, p 11-16. 1 Fig, 1 Ref.

Descriptors: *Watershed management, *Erosion control, *Cost analysis, Planning, *Political aspects, Sediments, Evaluation, Road construction, Logging, Volcanoes, Governmental interrelations, *Mount St Helens, *California, Redwood Creek.

Many major watershed rehabilitation projects begin in an uneasy, high-profile, hurried, politically charged environment. Despite differences in physical setting, ultimate objectives, and other considerations, these political factors result in a set of problems common to many watershed rehabilitation projects. Watershed rehabilitation projects at Redwood Creek, California, and Mt. St. Helens, Washington, present some instructive contrasts and similarities. Legislation expanding Redwood National Park provided for rehabilitation of lands affected by road construction and timber harvest. This project is funded for an anticipated program of 10 to 15 years, planned and conducted in part by scientists, and managed by a single Federal agency. The 1980 erruption of Mt. St. Helens, on the other hand, triggered a mix of responses by many agencies and organizations working with overlapping responsibilities in a crisis environment. Planning horizons for treating watershed problems at Mt. St. Helens have generally spanned only a matter of months to a few years, in part because funding for rehabilitation and hazard control has come in short-term allocations for specific projects. Examination of these two quite different projects reveals five criteria for successful, efficient design and execution of a large watershed rehabilitation project: state long-term and short-term objectives; use an interdisciplinary approach at all stages; consider erosion processes and fate of sediment in planning erosion control measures; define costs of full, partial, and no treatment; and provide independent evaluation of programs. (Moore-SRC)
W82-06968

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,
Humboldt State Univ., Arcata, CA., Dept. of Geology.
A. K. Lehre, B. Collins, and T. Dunne.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April, 1982, p 215-234. 6 Fig, 6 Tab, 11 Ref.

Descriptors: *Volcanoes, *Sediment erosion, *Sediment transport, *Mount St. Helens, Landslides, Mudflows, Tephra, Particle size, Aerial photography, Gravel, Sand, Silt, Mass wasting, Toutle River, *Washington.

The 18 May 1980 eruption of Mt. St. Helens greatly altered the drainage basin of the North Fork Toutle River. The lateral blast destroyed vegetation and deposited up to a meter of gravelly and sandy ash on hillslopes in 336 sq km of the drainage north and west of the mountain; subsequent airfall mantled these deposits with 0.02-0.06 m of poorly-permeable silty ash. A massive rockslide-avalanche filled 60 sq km of the upper North Fork Valley with volcanic rubble 5-195 m thick. Volcanic mudflows covered the banks and floodplain of the North Fork with 0.5-5 m of sand, silt, and gravel. Rapid erosion of these deposits has created major sediment management problems on the North Fork and its tributaries. Simple field and airphoto measurements were used to estimate the quantity and particle-size distribution of sediment contributed from each source. From June 1980-May 1981, a total of 55,000,000 cu m of sediment (35% gravel, 47% sand 18% silt/clay) was eroded in the drainage, chiefly (77%) from the debris avalanche. Between 33 and 45% of this sediment was redeposited in the system. Net sediment yield to the Main Toutle was 30,000,000 to 37,000,000 cu m, of which 39% was gravel, 46% sand, and 15% silt/clay. It is anticipated that sediment yields over the next several years will be no larger than that of the first year; yields will continue on the order of

10,000,000 to 30,000,000 cu m/yr, with the avalanche the most important source. (Moore-SRC)
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,
Washington Univ., Seattle. Dept. of Geological Sciences.
B. Collins, T. Dunne, and A. K. Lehre.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April 1982, p 82-97. 10 Fig, 7 Tab, 11 Ref. PNW-80-179.

Descriptors: *Volcanoes, *Sediment erosion, *Erosion rates, *Mount St. Helens, Tephra, Sheet erosion, Rill erosion, Sediment transport, Slopes, Vegetation, *Washington, Toutle River.

The 1980 eruptions of Mount St. Helens resulted in the widespread destruction of vegetation and deposition of 70,000,000 cu m of tephra on hillslopes covering a 352 sq km area in the drainage basin of the North Fork Toutle, South Fork Toutle, and Green Rivers. Since the eruption, these tepha and underlying colluvium have been eroded into the streams of the Toutle River System by sheet wash and rill wash. Local rates of erosion ranged between 500 and 74,500 cu m/sq km/year and were controlled by surface cover, hillslope gradient, tephra thickness, and tephra texture. During the first post-eruption year, 7,600,000 cu m of tephra and 1,300,000 cu m of colluvium eroded from the basin. These values represent erosion rates of 21500 cu m/sq km/year and 3600 cu m/sq km/year of tephra and colluvium, respectively, equivalent to a denudation of 25.1 mm/year. Thirty-one percent of all sediment eroded from hillslopes was trapped in lakes impounded by the debris avalanche that filled the North Fork Toutle River valley on 18 May 1980. Of the remaining 8,000,000 t of sediment that entered streams of the Toutle River system, 36% was clay and silt, 58% was sand, and 6% was gravel. (Moore-SRC)
W82-06971

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 5F.
W82-05932

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,
Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-05934

IDENTIFICATION OF ATYPICAL COLIFORMS FROM PUBLIC WATER SUPPLIES IN MISSOURI,
Missouri Univ., Columbia. Dept. of Civil Engineering.
S. K. Banerji, and L. Laohaviranit.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243585, Price codes: A03 in paper copy, A01 in microfiche. Report, March 1982. 17 p, 5 Tab, 16 Ref, 1 Append. OWRT A-121-MO(1), 14-34-0001-0127.

Descriptors: *Coliforms, *Pseudomonas, *Bacterial analysis, Water pollution sources, *Drinking water, Bacteria, Water analysis, *Water treatment, Contamination, Pollutants, Water conveyance, Culture media, Culturing techniques, Water pollution, Water pollution control, Water pollution treatment, Water quality, *Missouri.

Membrane filter plates containing atypical coliform colonies in water samples were obtained from Columbia and seven other Missouri manicipalities. Of the 71 pink-to-red atypical coliform colinies isolated, 94% were gram- negative rods, with the remainder being gram-negative Coccobacilli. The rods were identified as: Pseudomonas (44.8%), Enterobacter (22.3%), Klebsiella (6%), Aeromonas (4.5%), Alcaligenes (4.5%), and Citrobacter (2.9%). Those colonies unidentified included: fermetative-oxidase-positive and -negative (6% each), and nofermentative-oxidase-positive and-hegative (1.5% each) bacteria. The gram-negative Coccobacilli were classifies as either Pasteurella, Haemophilis, of Actinobacillus, due to uncertainites in the assay method. Many of these atypical coliforms have the potential of being a human/animal pathogen. Futher sutdy is needed to assess the significance of the presence of these organisms on the health of the populations served by these water supplies. Research is also needed to assess, the survival characteristics of these organisms during various water treatment operations. (Zilelinski-MAXIMA)
W82-05935

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,
Beckman Instruments, Inc., Carlsbad, CA.
A. A. Bulich.
Process Biochemistry, Vol 17, No 2, p 45-47, March/April, 1982. 6 Tab, 5 Ref.

Descriptors: *Bioassay, *Toxicity, *Industrial wastewater, Water pollution effects, Monitoring, Microtox, Fish, Daphnia, Bacteria, *Pollutant identification.

The toxicity of aquatic samples was monitored by a bioassay method (Microtox), based on changes in the light output of luminescent bacteria as measured with a photometer. A freeze dried preparation of Photobacterium phosphoreum was reconstituted, the sample was diluted to 5 concentrations from 5 to 50% and light measurements were made initially and 5 min later. LC50 was readily calculated from a formula. A total of 257 samples of wastewaters and effluents were tested. The Microtox test results agreed with in 1.5 orders of magnitude for 97.5% of fish toxicity vs. Microtox result s and 96.1% of Daphniz toxicity vs. Microtox results. The Daphnia test was more sensitive that the Microtox bioassay. The Microtox system, which requires only 30 min, provides a rapid, low cost method of monitoring effluents, screening new chemical products, and determining the toxicity of fluids prior to disposal. (Cassar-FRC)
W82-05951

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,
Genoa Univ. (Italy). Fisiologia Generale.
For primary bibliographic entry see Field 5C.
W82-05983

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,
Canada Center for Inland Waters, Burlington (Ontario).
T. Bistricki, and M. Munawar.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 506-509, March, 1982. 4 Fig, 5 Ref.

Descriptors: *Metals, *Algae, *Electron microscopy, *Pollutant identification, *Heavy metals, Diatoms, Flagellates, Phytoplankton, Chlorophyta, *Great Lakes, Bioaccumulation, Accumulation, X-ray spectroscopy.

Heavy metals were determined in samples of phytoplankton by electron microscopy combined with an energy dispersive x-ray spectrometer and a computer-based processing system. Spectra of several species showed inherent structural components as well as elevated levels of some metals. Staurastrum paradoxum, a green alga, contained elevated levels of Mn, Cu, Fe, and Al. Cyclotella sp., a diatom, contained Cu even though the water was low in Cu (2 micrograms per liter). Rhodomonas minuta, a phytoflagellate, showed peaks of Pb, Fe, Cu, and Os. These findings confirm that certain nanoplankters can be used as indicators of heavy metal pollution. (Cassar-FRC)
W82-05993

APPLICATION OF NUCLEAR DOUBLE RESONANCE TECHNIQUE FOR DETECTION OF PESTICIDES IN WATER AT LOW CONCENTRATIONS,
Institut Jozef Stefan, Ljubljana (Yugoslavia).
R. Osredkar, and P. K. Kadaba.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 513-518, May, 1982. 4 Fig, 5 Ref.

Descriptors: *Pollutant identification, *Pesticides, *Nuclear magnetic resonance, *Wastewater analysis, Carbamate pesticides, Organic pesticides, Triazine pesticides, Industrial wastes, Pollutants, Separation techniques.

The nuclear double resonance (NDR) technique was applied to the detection of organochlorine and carbamate pesticides at low concentrations in water. The method utilizes the strong nuclear magnetic resonance signal of an abundant spin system to detect the weak nuclear resonance of the spin species. Bromoform is used as solvent for the extraction of chlorinated pesticides, and chloroform is used in the case of non-chlorinated carbamate pesticides. The minimum detectable concentrations of the test compounds cabanolate, barban, CIPC, atrazine, and simazine were 20, 20, 20, 100, and 100 ppb, respectively. The NDR method in its present form is less sensitive than the electron capture gas chromatography method, but requires less eleborate clean-up and separation procedures. NDR may be used to analyze organochlorine and triazine pesticides in wastewater provided the concentration of these contaminants is between 10 and 100 micrograms/liter. In its present form, the instrument is not recommended for routine analysis. Improvements in sensitivity may be realized by using a liquid nitrogen-cooled ferrite-cored electromagnet, increasing the polarizing field, and introducing a two-magnet system. (Geiger-FRC)
W82-06004

SIMPLE PROCEDURES FOR ENRICHMENT OF CHLORINATED AROMATIC POLLUTANTS FROM FAT, WATER AND MILK FOR SUBSEQUENT ANALYSIS BY HIGH-RESOLUTION METHODS,
Karolinska Inst. Stockholm (Sweden). Dept. of Physiological Chemistry.
B. Egestad, T. Curstedt, and J. Sjovall.
Analytical Letters, Vol 15, No 3, p 293-307, 1982. 5 Tab, 26 Ref.

Descriptors: *Pesticides, *Gel chromatography, Pollutant identification, DDT, *Chlorinated hydrocarbons, *Aromatic compounds, Water analysis, Insecticides, Sample preparation, Polychlorinated biphenyls.

Lipidex 1000 and 5000, lipophilic gels, were suitable for extraction and purification of nonpolar chlorinated aromatic pollutants (DDT, polychlorinated biphenyls, and tetrachlorodibenzodioxin) in water, milk, and butter. A 1-liter water sample containing 50,000 cpm DDT labeled with C14 was passed through a 2 ml gel bed (Lipidex 1000) at the rate of 50 ml per min. Recovery of DDT by elution with 10 ml methanol was 96.6%. (Cassar-FRC)
W82-06015

HEADSPACE CHROMATOGRAPHIC DETERMINATION OF WATER POLLUTANTS,

Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. Otson, and D. T. Williams.
Analytical Chemistry, Vol 54, No 6, p 942-946, May, 1982. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Water analysis, *Gas chromatography, Drinking water, Potable water, Organic compounds, Chemical analysis, Water quality, *Pollutant identification.

A modified purge and trap technique is presented for the evaluation of potentially hazardous volatile organics in Canadian potable water supplies. The method employs on-column trapping and simultaneous use of flame ionization and electrolytic conductivity detectors to develop a dynamic headspace gas chromatographic technique. Forty-two organics in water were evaluated, with detection limits of less than 1 microgram/liter. Linear plots of peak area against concentration were obtained in the range of 0.25-16 micrograms/liter for 32 compounds. At aqueous concentrations of 4 and 16 micrograms/liter, peak area precision of less than 10% relative standard deviation for triplicate sample analyses and purging efficiencies of greater than 75% were generally obtained. Storage of aqueous composite standard solutions at 4 and 16 micrograms/liter for 6 weeks at 4 degrees centigrade did not usually affect the analytical results by more than 15%. Poor precision of results was often due to inconsistent and inaccurate peak area integration, which generally occurred for small peaks or when peaks were closely clustered. These problems were primarily due to the fact that integration parameters were established at the start of the automated gas chromatographic analyses and could not be optimized for each sample and compound. (Baker-FRC)
W82-06016

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,
Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
H. Klimowicz.
Acta Hydrobiologica, Vol 23, No 1, p 47-67, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Zooplankton, Water quality, Water pollution effects, *Vistula River, Warsaw, *Poland, Rivers, Plankton, Wastewater pollution, Saprophytic bacteria, Species composition, Bacteria.

An investigation of plankton in a 59 km reach of the River Vistula at Warsaw, Poland, indicated a saprobity index of 1.9 for phytoplankton and 2.1 for zooplankton and a water quality class of 2, requiring treatment before consumption. The sampling was done twice a month over two annual cycles, from February 1977 to April 1979. A total of 128 plant taxa and 152 animal taxa were identified. The most common were Rotatoria (72 species), Bacillariophyta (67), Ciliata (54), Euglenophyta, (15), and Cladocera (9). The composition and numbers of plankton depended on water fertility, season, and water temperature. The same plankton species dominated the community in the same seasons of both years. Species compositions were similar above and below sewage inflow points, probably because the Vistula is deep and wide. (Cassar-FRC)
W82-06021

CONTINUOUS MONITORING OF CYANIDE CONCENTRATION IN SURFACE WATER (KONTINUIERLICHE UBERWACHUNG DER CYANID-KONZENTRATION IN OBERFLACHENWASSER),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
F. Dietz, H. D. Frank, and G. Teske.
Wasser, Luft und Betrieb, Vol 26, No 1/2, p 17-21, 1982. 6 Fig, 2 Tab, 15 Ref. (No English summary).

Descriptors: *Cyanide, Surface water, *Monitoring, Pollutants, Rivers, Potassium compounds, Heavy metals, Cadmium, Copper, Zinc, On-site investigations, Laboratory equipment, Potentiostatic measurement, *Federal Republic of Germany, *Ruhr River, *Pollutant identification.

The potentiostatic method of Schwarz and Simon for the continuous monitoring of cyanide concentrations in water was tested in the laboratory for accuracy and, following successful results, in situ on the bank of the Ruhr River in the Federal Republic of Germany. With this method, the substance to be measured does not participate in the charge exchange on the measuring electrode but reacts with the metal ions of the electrode (in this case, cyanide reacts with silver). The apparatus used in the method is the DIGOX CN-2. Distilled water was used as a control. Ruhr water with an added concentration of 50 micrograms CN/;iter was tested, and the DIGOX CN-2 registered 76% of potassium cyanide compared with control, all cyanide in copper, zinc, and cadmium complexes, but only 4-7% in nickel complexes; registering of cyanide-iron complexes was expectedly low. Results showed that the added cyanide ions were not taken up by heavy-metal solutions even after several days. In situ, the apparatus was set up in a guage station. The efficiency of the system was tested by dosing the analysis block with a solution of 50 micrograms CN/liter with a stabilized solution of 500 micrograms/liter potassium cyanide. The solution was practically unchanged after a week. The practicalities of setting up and maintaining the system are discussed. (Gish-FRC)
W82-06023

ON THE LIMITS OF DETECTION OF TRACES OF VOLATILE ORGANICS IN WATER, USING AMBERLITE XAD-2 RESIN,
La Trobe Univ., Bundoora (Australia). Dept. of Physical Chemistry.
R. Care, J. D. Morrison, and J. F. Smith.
Water Research, Vol 16, No 5, p 663-665, May, 1982. 2 Tab, 16 Ref.

Descriptors: *Ion exchange, *Organic compounds, *Detection limits, *Pollutant identification, Resins, Trace levels, Hydrocarbons, Water analysis, Amberlite XAD-2 resin.

XAD-2 resin proved unsuitable for detection of very low levels of organic compounds in water. In blank Experiments the well-cleaned resin continued to emit trace amounts (0.1-1 ppb) of toluene, styrene, benzene, undecane, and substituted benzenes when extracted with diethyl ether. The source of the hydrocarbons may be breakdown of the resin or residues from breakdown under the Soxhlet cleaning procedure. (Cassar-FRC)
W82-06028

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,
National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen, and A. Malherbe.
Water Research, Vol 16, No 5, p 745-748, May, 1982. 3 Fig, 16 Ref.

Descriptors: *Wastewater analysis, *Organic compounds, *Pollutant identification, Gel permeation chromatography, Activated sludge process, Organic carbon.

Determination of molecular mass distribution of dissolved organic carbon in wastewater effluent by gel permeation chromatography produced serious errors. About 57% of the dissolved organic carbons were in the undefined region spread over 90 fractions, many of which contained sub-milligram quantities of organic carbon. The largest error was produced by background interference from the gel column. (Cassar-FRC)
W82-06030

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
J. L. Slabbert, and W. S. G. Morgan.
Water Research, Vol 16, No 5, p 517-523, 1982. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Bioassay, *Oxygen uptake, *Toxicity, *Pollutant identification, Water pollution effects, Tetrahymena pyriformis, Protozoa, Water analysis, Industrial wastewater, Ammonium, Cadmium, Copper, Cyanide, Lead, Mercury, Parathion, Pentachlorophenol, Phenol, Zinc.

The respiratory response of the protozoan, Tetrahymena pyriformis, was used in a bioassay procedure to detect toxic substances. The simple technique produced results within 10 min. Oxygen uptake rates of the organisms in test solutions were compared with that of the control, 7.2% per min. Minimum concentrations in mg per liter of the toxic substances detectable by this method were: ammonium-N, 270-275; cadmium, 0.1-0.5; copper, 0.1-0.5; cyanide, 0.013-0.014; lead, 0.001-0.01; mercury, 0.1-0.5; parathion, 0.01-0.05; pentachlorophenol,0.005-0.01; phenol, 85-90; and zinc, 0.1-0.5. Although this method is not sensitive enough to detect most substances at the levels used in drinking water standards, it is suitable for monitoring industrial effluents. (Cassar-FRC)
W82-06032

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol 16, No 5, p 551-557, May 1982. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Organic compounds, *Phenols, *Aromatic compounds, *Pollutant identification, Water pollution sources, *Fate of pollutants, *Tokyo, Japan, Organic acids, Phenolic acids.

Samples of polluted river waters in the Tokyo area and unpolluted river, brook, reservoir, and pond waters from the Ogasawara (Bonin) Islands were analyzed for phenols and aromatic acids. The phenolic acids (p-hydroxybenzoic, vanillic, syringic, p-coumaric, and ferulic acids) and o- and m-hydroxybenzoic acids were found at concentrations of < 1 micrograms per liter in both polluted and unpolluted waters. The major sources of the phenolic acids were vascular plants and their detritus. Pentachlorophenol, Bisphenol A, and terephthalic and trimesic acids, found in polluted waters but not in unpolluted waters, were attributed to human activity (pesticides, industrial wastes). The ratios of p-coumaric and ferulic acids exressed as carbon/total organic carbon and the ratios of these acids expressed as carbon/extractable organic carbon with ethyl acetate suggest that the contributions of vascular plants to polluted and unpolluted waters are not nearly equal. Ratios of syringic acid (not found in most gymnosperms) to vanillic acid were higher in polluted waters, indicating a smaller contribution of angiosperms relative to gymnosperms in polluted waters than in unpolluted waters. (Cassar-FRC)
W82-06033

INFLUENCE OF TEMPERATURE AND TIME OF INCUBATION ON THE ESTIMATION OF BACTERIAL NUMBERS IN TROPICAL SURFACE WATERS,
Singapore Univ. Dept. of Microbiology.
W. C. Jen, and R. G. Bell.
Water Research, Vol 16, No 5, p 601-604, May, 1982. 2 Fig, 13 Ref.

Descriptors: *Bacterial analysis, *Incubation, *Temperature effects, *Pollutant identification, Tropical regions, Water analysis, Heterotrophic bacteria, Singapore.

An incubation regime of 30 C for 72 hours was recommended as a standard procedure for Aerobic Plate Counts of bacteria in warm tropical surface waters. This conclusion was reached after statistical analysis of results from incubation experiments

on water samples collected from a flowing storm drain in Singapore, April-September 1980. Samples were incubated at 20, 25, 20, 35, and 40 C for periods of 24, 48, 72, 96 and 120 hours. Using a reference point of 20 C and 120 hours incubation, the 30 C regime had 120% of the cumulative plate counts, 25 and 35 C had about 95%, and 40 C had about 50%. All temperature curves leveled off at or before 72 hours. The results are consistent with the knowledge that bacteria in the tropics are well adapted to growing at 18-30 C. (Cassar-FRC)
W82-06037

DETERMINATION OF PHOSPHATE IN WASTEWATER BY ION-EXCLUSION CHROMATOGRAPHY WITH FLOW COULOMETRIC DETECTION,
Government Industrial Research Inst., Nagoya (Japan).
K. Tanaka, and T. Ishizuka.
Water Research, Vol 16, No 5, p 719-723, May, 1982. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Phosphates, *Wastewater analysis, *Chromatography, Ion exchange, Ion exclusion chromatography, *Pollutant identification, Resins, Industrial wastewater.

Phosphates were determined in wastewater samples by ion exclusion chromatography on a cation exchange resin in H+ form by elution with acetone-water. A flow coulometric detector was more effective than a conductometric detector. The chemical reaction of H+ ion formed from H3PO4 and p-benzoquinone was monitored at a constant applied potential (+0.45V vs. Ag-AgI). Reasonable separation of phosphate from coexisting strong acid ions (chloride, sulfate, and nitrate) and carbonate was attained by elution with 60% (v/v) acetone-water. The calibration graph with the flow coulometric detector was linear over the concentration range 1-150 ppm. Results of analysis of influents and effluents from domestic and industrial wastewater samples by the present method and by the molybdenum blue method showed excellent agreement. (Cassar-FRC)
W82-06040

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5D.
W82-06048

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,
Central Electricity Research Labs., Leatherhead (England).
For primary bibliographic entry see Field 2K.
W82-06052

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. E. McIntyre, and J. N. Lester.
Environmental Pollution, Series B, Vol 3, No 3, p 225-230, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Organic compounds, *Sludge, Pollutant identification, Water pollution sources, Industrial wastes, Pesticides, *Insecticides, *Organochlorines, *Polychlorinated biphenyls, England, *Path of pollutants.

A study was undertaken to assess the magnitude and range of polychlorinated biphenyl (PCB) and organochlorine insecticide (OCL) concentration in a representative sample of British sewage sludges and to consider the possible implications of the results of sewage sludge disposal options. Grab samples of sludges from primary, mixed primary, and digested treatment stages were collected from forty sewage treatment works in England, covering seven Water Authority areas. The method of analysis involved solvent extraction with hexane, cleanup by alumina/alumina-silver nitrate column chromatography, fractionation of PCB and OCL on a silica gel column, and analysis by electron capture gas-liquid chromatography. PCB concentrations appear to have diminished in England since 1970. Concentrations of lindane, DDE and dieldrin were found to be in the low microgram/gram range or less. Possible sources of these micropollutants in sewage and sludges are discussed. Dieldrin has been used both in industry as a mothproofing compound for woollen products and in agriculture as a pesticide, but its use has recently been restricted. Lindane is used in industry and in the home for wood preserving in insecticidal formulations in addition to its agricultural use. (Baker-FRC)
W82-06081

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Landsberger, R. E. Jervis, R. Lecomte, P. Paradis, and S. Monaro.
Environmental Pollution, Series B, Vol 3, No 3, p 215-223, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Sulfur, *Snow, *Pollutant identification, Monitoring, *X-ray emission, Chemical analysis, Montreal, Canada, Path of pollutants.

This paper reports the use of PIXE techniques in the quantitative determination of the total sulfur concentration in snow from the highly industrialized city of Montreal. Proton induced X-ray emission (PIXE) employs a proton beam of 1.6 MeV to bombard the targets. A simple pre-concentration technique enabled the method to achieve detection limits as low as 19 ng/g for total sulfur concentration in snow. An overall precision of 10% was achieved. Snow samples were gathered over a 24-hr period at four different locations around the perimeter of the island of Montreal. The latter part of February 1979 was chosen as the time to obtain the maximum amount of undisturbed snow in a single season. The northwest site, which is generally perceived as a less polluted area, had a sulfur concentration less than three times lower than the southeast site. The southeast site had shown one of the highest detectable amounts of sulfur dioxide in an earlier study. The PIXE method is recommended as a convenient, non-destructive technique for rain, lake or river water analyses. (Baker-FRC)
W82-06082

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,
Ben-Gurion Univ. of the Negev, Geersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 3, p 333-346, June, 1980. 4 Tab, 5 Fig, 14 Ref.

Descriptors: Wastewater, *Recycling, *Ion exchange, Cost analysis, Desalination, Municipal effluent, Water reuse, Wastewater treatment.

Recycling of waste water by ion exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime flocculation, served as a feed for the ion-exchange system. Partial desalinatin was achieved by allowing part of the feed to bypass the strong acid cation exchanger. The salt concentration was decreased from 15meq/1 (750 ppm as CaC03) to 7-10 meq/1 (350-500 ppm as CaCO3) and the organic matter, from 70-100 mg /1 COD (Chemical oxygen demand) to about 25 mg/1. The leakage of organic matter in the partial desalination mode was somewhat higher than that found in complete desalination. The resins were found to be highly resistant to an attack of organic matter over a period of one year. Three possible resin arrangements were investigated, and a cost analysis for one of them is presented. Since inexpensive chemicals, such as H2SO4 and Ca(OH)2, can be used for regeneration the system provides an economical method for recycling waste water for industry and agriculture. (Balaban-Boston)
W82-06117

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243619, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 29, September 1981. 47 p, 8 Fig, 8 Tab, 49 Ref, 1 Append. OWRT A-012-GUAM(1), 14-34-0001-9012.

Descriptors: *Diatoms, *Water analysis, *Bioindicators, *Microscopic analysis, Water sampling, Nitzschia, Gomphonema, Water quality, Impaired water quality, Aquatic life, Aquatic populations, Urban runoff, *Indicators, Nutrient requirements, Nutrients, Nitrates, Phosphates, *Guam, Periphyton, *Pollutant identification.

Periphytic diatoms were collected on immersed glass slides in five bodies of polluted/unpolluted freshwater for 10-14 days, concomitant to the collection of water samples on three separate days. The water samples were analyzed for 22 water quality parameters. Natural surfaces (plants, rocks, sediments) were also sampled for comparison of inhabitant diatom assemblages with the glass slide collections. Data from counting at least 750 diatom frustules on randomly-selected slide areas were used to calculate species diversity indices, a sample similarity index, and to determine whether diatom assemblages occur according to water quality or habitat type. Bodies of water from urban runoff had diatoms dominated by Nitzschia palea and low species diversity, particularly where nutrient (nitrate and phosphate) enrichment occurred. Gomphonema parvulum diatoms dominated ponded habitats where mineral nutrients were excessively low (below 0.020 mg/liter). High sample similarity between river stations over time indicated that district diatom assemblages exist accordig to water quality and habitat type. It was also noted that less diatom species numbers (over 33%) and species diversity occurred on the slides than on the natural substrata samples. (Zielinski-MAXIMA)
W82-06146

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W82-06158

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5C.
W82-06168

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,
Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W82-06169

ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,
Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5D.
W82-06178

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,
Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
M. Silva, and M. Valcarcel.
Analyst, Vol 107, No 1274, p 511-518, May, 1982. 2 Fig, 5 Tab, 37 Ref.

Descriptors: *Copper, *Water analysis, *Pollutant identification, *Atomic absorption spectrometry, Heavy metals, Trace metals, Analytical techniques.

This paper describes a sensitive method for the determination of trace amounts of copper by atomic absorption spectrometry after extraction using 1,2-naphthoquinone (NQT) and isobutyl methyl ketone (IBMK). The NQT complex is stable in IBMK medium. The method has been successfully applied to the determination of copper in water, food and analytical reagents. By this method copper concentrations in the nanogram per milliliter range can be determined. It is possible to extract the complex over a wide range of acidities, and the complex is very stable in IBMK solution. In most instances the method offers a greater sensitivity for the determination of copper. The coefficient of variation is generally smaller than that found in other determinations. By the NQT method, higher ratios of foreign ions can be tolerated than is the case when other reagents are used. By extraction into IBMK the formation of toxic products in the flame is avoided. (Baker-FRC)
W82-06179

DETERMINATION OF SULPHIDE IN INDUSTRIAL WASTE WATERS AND SEWAGE WATERS WITH AN IODIDE-SELECTIVE ELECTRODE,
Sofia Univ. (Bulgaria). Faculty of Chemistry.
M. Novkirishka, G. Michailov, and R. Christova.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 305, No 1, p 411-412, March, 1981. 1 Tab, 2 Ref.

Descriptors: *Sulfides, *Pollutant identification, *Industrial wastes, Sewage, Chemical analysis, Water analysis, Iodometry, Potentiometers, Photometry, *Leather industry.

The sulfide content in leather industry waste waters and in sewage waters was determined in order to apply an indirect potentiometric method for the determination of sulfide by means of an iodide ion-selective electrode. The results obtained were compared with those obtained by means of standard methods such as photometry with dimethyl-n-phenylenediamine and iodometry. The reproducibility of the potentiometric method was similar to that of the photometric one. The standard deviation of both methods is of the same order of magnitude. The photometric method could not be applied to the determination of sulfides in sewage water, as their concentration is close to the detection limit. The iodometric method could not be used for these samples, as its sensitivity is quite poor and it has a high blank. The potentiometric method with the iodide ion-selective electrode was very fast, about 30 minutes per analysis, sensitive at 0.02 mg/liter, and reproducible. The method applied, using sulfide separation from the interferences, can be used for the determination of sulfides in samples with various and complex composition. (Baker-FRC)
W82-06192

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7C.
W82-06233

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,
CH2M/Hill, Atlanta, GA.
J. C. Nemeth, and T. H. Eck.
Tappi, Vol 65, No 5, p 171-175, May, 1982. 2 Fig, 8 Ref.

Descriptors: *Baseline studies, *Environmental effects, Case studies, *Bioindicators, *Pulp wastes, Data collections, Benthos, Water pollution effects, Pulp and paper industry, Industrial wastes, Physical properties, Water properties, Chemical properties, Water quality, *Georgia, Oconee River.

Site-specific baseline biological studies in receiving waters of pulp and paper mill effluents provide the basis for logical, non-inferential comparison of before-and after conditions. They also allow more efficient environmental impact studies for obtaining permit renewal and /or facility-expansion permits. A pre-operational aquatic biology study should include seasonal records on biotic factors, especially indicator organisms such as benthic macroinvertebrates, periphyton, and fish, and physical factors such as dissolved oxygen, air and water temperature, conductivity, pH, discharge rate and stage elevation and tape-down. The study plan for baseline data collections on the Oconee River near Dublin, Georgia, at a site which would receive discharge from a newly planned paper mill is described. In this case study, the information gained was adequate to characterize the existing quality of the water at a relatively low cost. (Geiger-FRC)
W82-06235

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,
Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5C.
W82-06267

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,
Northern Michign Univ., Marquette. Dept. of Chemistry.
D. L. Macalady, C. P. Granlund, J. G. Granlund, and S. L. Vervacke.
Water Research, Vol 16, No 7, p 1277-1283, July, 1982. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Iron, *Water analysis, Surface waters, Lakes, Rivers, Chemical analysis, Colorimetry, Measuring instruments, Pollutant identification.

Iron(II) analyses were conducted on oxygenated surface waters using bathophenanthroline. In the presence of dissolved, colloidal or complexed iron(III), the BPN method for iron(II) analysis employing pH values lower than 6.5 at extraction will unavoidably overestimate the concentration of iron(II) by a small but significant amount. The interference will increase dramatically as the pH at extraction is lowered. This potential for error must be added to results reported previously which were ascribed to the reduction of iron(III) under the influence of sunlight, acid and/or dissolved organic matter. A plausible explanation for this additional interference is the formation in the presence of FeOH(2+) of a complex which is spectroscopically similar to the BPN-iron(II) complex. The variable magnitude of this interference can therefore be ascribed to the presence of variable amounts of ferrous hydroxide in natural waters. This depends on the pH, the levels of colloidal iron(III) and organically complexed iron(III), and the analytical conditions used. These findings cast serious doubt on earlier claims made in the literature that measurable levels of ferrous iron and higher levels of acid digestible ferrous iron exist in the oxygenated surface waters of lakes. Several interferences from ferrous hydroxide in colorimetric analyses for iron(II) might also be expected using other complexing agents. (Baker-FRC)
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,
Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, J. M. Foght, and D. W. S. Westlake.
Water Research, Vol 16, No 7, p 1285-1290, July, 1982. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Mineralization, *Microorganisms, Lakes, Rivers, Surface water, *Monitoring, Fate of pollutants, Organic compounds, Biodegradation, Wastewater, *Pollutant identification.

A method is described for monitoring the mineralization of compounds in aqueous samples. In this method aliquots of both headspace gas and culture liquid were removed for analysis at various times. A single culture flask whose headspace gas was flushed periodically could not be used, since any carbon dioxide present is partitioned between the gas and liquid phases. The culture flask used contains 200 ml of sample with labeled substrate, and one control-replacement flask is readied with 200 ml of sterile sample with labeled substrate. At each sampling time, 1/40th of the liquid and headspace gas was removed from the culture flask for 14-CO2 recovery. This method was used to study mineralization of amino acids, starch, n-hexadecane and anthracene by microorganisms in river water, and of n-hexadecane and n-hexadecanoic acid by microorganisms in sewage effluent. To obtain a reasonable evaluation of the mineralization ability of an aquatic environment, representative samples must be subjected to the chosen analytical procedure, and the larger the sample volume, the more reliable the evaluation will be. The need for a larger sample volume is particularly important when dealing with unpolluted aquatic environments which have low densities of heterotrophic bacteria. (Baker-FRC)
W82-06272

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2K.
W82-06273

DETERMINATION OF ORGANOCHLORINES IN RIVER SEDIMENT BY CAPILLARY GAS CHROMATOGRAPHY, APPLICATION TO DUTCH RIVER SEDIMENT,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
R. C. C. Wegman, and A. W. M. Hofstee.
Water Research, Vol 16, No 7, p 1265-1272, July, 1982. 6 Fig, 5 Tab, 11 Ref.

Descriptors: *Water analysis, *Gas chromatography, Sediments, *Organochlorines, Rivers, *Netherlands, Organic compounds, Chemical analysis, *Pollutant identification, Monitoring.

Studies were conducted to develop a reliable method for the determination of a great number of organochlorines, including analyses in the presence of interfering PCBs and other co-extractives in river and harbor basin sediment. As an example of the practical application of this method, the results of a monitoring program in river and harbor basin sediment in the Netherlands are given. The sediment sample was shaken twice with acetone, followed by water partitioning. The decanted water-acetone phase was extracted twice with petroleum ether. Recoveries with this method were carried out for clay soil, peat soil and river sediment. Mean recoveries and SD of 15 organochlorines were determined. The recoveries for compounds C-601 and C-773, by-products of the aldrin and dieldrin synthesis, were only determined in river sediment 7 days after spiking and were 90% for both compounds. In the period 1979-1980 water samples from Boven Merwede and Lake Ketelmeer were

analyzed for 17 different organochlorines. Only HCB, alpha-HCH and gamma-HCH were found. The mean concentrations for the three were 0.09, 0.02 and 0.06 micrograms/liter in both water bodies. (Baker-FRC)
W82-06274

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
For primary bibliographic entry see Field 5F.
W82-06278

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W82-06280

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 4B.
W82-06309

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,
Foras Forbartha, Dublin (Ireland).
L. J. Lennox, and M. J. Flanagan.
Water Research, Vol 16, No 7, p 1127-1133, July, 1982. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Water analysis, Measuring instruments, Organic compounds, Industrial waste, Natural waters, *Kjeldahl procedure, *Pollutant identification.

A method of analyzing large numbers of samples accurately with the minimum amount of inconvenience is presented for determining total Kjeldahl nitrogen in surface fresh waters and organic wastes. The method calls for the conversion of organic nitrogen compounds to ammonium sulfate by a catalytic (red mercuric oxide) acid-sulfate digestion. The digestion time is 3 hr and allows a maximum of 36 samples, 2 blanks, and 2 standards to be processed simultaneously. No pH adjustment is required after the digestion. Calibration curves covering the ranges of 0.5 - 100 micrograms ammonium-nitrogen/liter and 10-1000 micrograms ammonium-nitrogen/liter were linear within 2%. The detection limit of the method was 0.5 micrograms total Kjeldahl nitrogen/liter. The concentration range of TKN for which the method is usable is 0.5 micrograms nitrogen/liter to 30 mg nitrogen/liter. The method displays a high tolerance to interferences from copper, iron, mercury and hardness. The digestion procedure gave a high recovery and reproducibility over a wide range of nitrogen compounds tested. The digestion procedure requires no supervision while in progress, and the colorimetric step for the determination of ammonia using a continuous flow method proceeds at a rate of 60 samples per hour. (Baker-FRC)
W82-06314

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,
Canviro Consultants Limited, Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W82-06392

ANALYSIS OF GEOTHERMAL WATERS BY SPARK SOURCE MASS SPECTROMETRY,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
R. Vandelannoote, W. Blommaert, R. Gijbels, and R. Van Grieken.
Fresenius Zeitschrift fur Analytische Chemie, Vol 309, No 4, p 291-294, 1981. 2 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Mass spectroscopy, *Trace elements, *Thermal water, Water analysis, Geothermal resources, Trace metals, Heavy metals, Thermal springs, Neutron activation analysis.

The analysis of trace elements in geothermal waters by the time consuming but sensitive method of spark-source mass spectrometry (SSMS) is described. To collect elements having quite different chemical properties such as alkalies, transition elements, and elements occurring in anionic form, a physical preconcentration step is recommended. Chemical preconcentration is carried out by cocrystallization on 1-(2-pyridylazo)-2-naphthol or chelation by 8-hydroxyquinoline followed by adsorption onto activated carbon. The relative sensitivity factors appear to be independent of the salt content of the graphite electrodes, but the precision of SSMS is slightly poorer than that obtained for neutron activation. However, SSMS has a more uniform elemental sensitivity and allows for the determination of elements for which neutron activation is not suitable, such as lead and tin. (Geiger-FRC)
W82-06464

DETERMINATION OF METHOMYL AND METHOMYL-OXIME IN FRUIT CROPS AND WATER BY HPLC,
Tieraerztlichen Hochschule, Hanover (Germany, F.R.). Chemical Inst.
M. A. Alawi, and H. A. Russel.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 309, No 1, p 8-12, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Insecticides, *High performance liquid chromatography, *Methomyl, Separation techniques, Water analysis, Carbamate pesticides, Pesticides, Pesticide residues, *Chromatography, Fruit crops.

A simple and specific quantitative high performance liquid chromatography (HPLC) technique for determining methomyl residues in water and fruit samples is described. Extraction is done with ethyl acetate, and HPLC separation is carried out on a reversed phase column with ultraviolet (UV) detection. The method allows simultaneous detction of methomyl and its degradation product, methomyl-oxime. Using a combined detection system of UV- and electrochemical detectors in series, methomyl could be determined at the 1 nanogram/milliliter level and methomyl-oxime at the 100 picogram/milliliter level in water. The recovery rate in the range of 0.01-1 micrograms/gram was 101.4 plus or minus 6% in fruit crops (apples) and 93.7 plus or minus 4% in water. (Geiger-FRC)
W82-06466

NEW HIGH-PERFORMANCE ANALYTICAL PROCEDURE FOR THE VOLTAMMETRIC DETERMINATION OF NICKEL IN ROUTINE ANALYSIS OF WATER, BIOLOGICAL MATERIALS AND FOOD,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Dept of Chemistry.
B. Pihlar, P. Valenta, and H. W. Nurnberg.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 307, No 5, p 337-346, 1981. 8 Fig, 4 Tab, 35 Ref.

Descriptors: *Nickel, Water analysis, *Metals, *Heavy metals, *Pollutant identification, *Voltammetry.

Trace levels of nickel were determined in water, wastewater, and other materials by voltammetry. DC or differential pulse voltammetry was applied after prior interfacial accumulation by an adsorption layer of dimethygloyoximate at the hanging mercury drop electrode. In aqueous media as little as 1 ng per lier of Ni may be detected with good precision and accuracy. The pretreatment for natural water involved filtration of particulate matter; ultraviolet irradiation to release heavy metals bound to organic matter; determination of Cu, Pb, Cd, and Zn in acid solutions; determination of Ni and Co after neutralization with 0.5 ml of 4M ammonia-ammonium chloride buffer, and addition of 20 microliters of 0.1 M dimethylglyoxime to a 20 ml sample. Nickel levels (in micrograms per kg) in some aqueous samples were 0.187 in a tap water; municipal wastewater, 1.49; municipal wastewater effluent, 3.96; and rain water at Dortmund, Germany, 4.73. (Cassar-FRC)
W82-06467

A RAPID HIGH-PERFORMANCE LIQUID-CHROMATOGRAPHIC METHOD FOR SIMULTANEOUSLY DETERMINING THE CONCENTRATIONS OF TFM AND BAYER 73 IN WATER DURING LAMPRICIDE TREATMENTS,
Fish and Wildlife Service, La Crosse, WI.
V. K. Dawson.
Canada Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 778-782, May, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Chromatography, *Lampricides, High performance liquid chromatography, Water analysis, Pesticides, Lamprey, Spectrophotometry, Pesticides, *TFM, *Bayer 73.

A high-performance liquid-chromatography (HPLC) method was developed for detecting as little as 0.005 milligram/liter of 3-trifluoromethyl-4-nitrophenol (TFM) and Bayer 73 lampricides simultaneously in water. The procedure requires only minutes per sample and is specific. A combined buffer and internal standard reagent is added to the water sample, which is then injected through a Sep Pak C18 disposable cartridge. The cartridge adsorbs and retains both the lampricides and the internal standard. Elution with methanol provides cleanup and concentration of the sample before HPLC analysis on an MCH 10 reverse phase column. A methanol:acetate buffer acts as the mobile phase at 2 milliliter/min and detection occurs by ultraviolet spectrophotometry at 330 (or 254) nanometers. A microprocessor data system quantifies off-scale peaks and gives results directly in milligram/liter. (Geiger-FRC)
W82-06495

EVALUATION OF COLIPHAGE DETECTION AS A RAPID INDICATOR OF WATER QUALITY,
Atlantic Research Corp., Alexandria, VA.
R. S. Wentsel, P. E. O'Neill, and J. F. Kitchens.
Applied And Environmental Microbiology, Vol 43, No 2, p 430-434, February, 1982. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Bioindicators, Water quality, *Coliforms, Bacteriophage, *Coliphage, Bacterial analysis, Microbiological studies, *Pollutant identification.

Thirteen water quality laboratories throughout the United States participated in a program to evaluate the effectiveness of ARCAT (a rapid coliphage analysis technique) in enumerating coliphages in natural waters and to verify correlations between coliforms and coliphages in these water systems. Water samples were analyzed for fecal and total coliforms and for coliphages detected by the broadrange Escherichia coli C host. The data were analyzed statistically to determine whether a relationship existed between fecal or total coliforms and coliphages. A linear relationship was found to exist between coliphages detected with the E. coli C host and fecal or total coliforms. These correlations were highly significant. These study results demonstrate that the ARCAT procedure provides a rapid, inexpensive means for enumerating coliphages in waters containing at least six coliphages per 100 milliliters within 6 hours. The coliphage levels can then be related to coliforms to give a quick indication of the number of coliform bacteria in potentially contaminated waters. The sensitivity of the test must be improved before it can be used for potable water systems. (Carroll-FRC)
W82-06537

DETERMINATION OF THE NUMBER OF RESPIRING THIOBACILLUS FERROOXIDANS CELLS IN WATER SAMPLES BY USING COMBINED FLUORESCENT ANTIBODY-2-(P-IO-

DOPHENYL)-3-(P-NITROPHENYL)-5-PHENYLTETRAZOLIUM CHLORIDE STAINING,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. H. Baker, and A. L. Mills.
Applied and Environmental Microbiology, Vol 43, No 2, p 338-344, February, 1982. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Population density, *Bacteria, *Microbiological studies, *Fluorescence, Respiration, Chloride, Phenols, *Bacterial analysis, Natural waters, *Standing crops, *Pollutant identification.

Direct counting of microbial cells stained with fluorescent dyes is a commonly used method for determining the total standing crop of microorganisms in natural habitats, but it cannot differentiate specific types of bacteria nor distinguish between live and dead cells. The reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyltetrazolium chloride (INT) to extractable formazan has been shown to be correlated with oxygen uptake and respiratory activity. A simple method has been developed for combining fluorescent antibody staining and INT reduction to determine the numbers of viable Thiobacillus ferrooxidans cells in aquatic habitats. The procedure, called FAINT, provides a rapid, accurate measure of species-specific numbers of active cells and is more sensitive than conventional cultural techniques by at least one order of magnitude. The technique was used to investigate the distribution of T. ferrooxidans in both acidic and nonacidic sites. Comparisons among the FAINT technique and fluorescent antibody staining alone or most-probable-number determinations in 9K broth showed that the use of most-probable-number techniques resulted in an underestimation of the number of viable cells by one to three orders of magnitude, while the fluorescent antibody counts resulted in overestimation of the number of viable cells. The amount of difference varied with the sample site. (Carroll-FRC)
W82-06542

FRACTIONATION OF METAL FORMS IN NATURAL WATERS BY SIZE EXCLUSION CHROMATOGRAPHY WITH INDUCTIVELY COUPLED ARGON PLASMA DETECTION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, P. F. Landrum, and D. A. Yates.
Analytical Chemistry, Vol 54, No 7, p 1196-1198, June, 1982. 2 Fig, 16 Ref.

Descriptors: *Metals, *Magnesium, *Calcium, *Pollutant identification, Water analysis, *Chromatography, Trace metals, Chelation, Chemical analysis, Separation techniques.

Distilled water size exclusion chromatography with inductively coupled argon plasma detection was used to fractionate and measure forms of dissolved metals in natural water filtrates. Chromatograms for Ca and Mg showed three peaks each, suggesting the existence of three forms of each metal (possibly two associated with dissolved organic matter and the third with metal carbonates) in the samples of Grand River and Lake Michigan waters. The separation mechanisms involve both molecular size and component polarity. For example, hydration enlarges molecular size. The type and size of the complexing anions also influence the fractionation behavior. (Cassar-FRC)
W82-06545

AMES SALMONELLA MUTAGENICITY ASSAYS ON WATER: DICHLOROMETHANE EXTRACTS VERSUS PREPARATION OF GROWTH MEDIA WITH TEST SAMPLES,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, W. O. K. Grabow, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 641-646, June, 1982. 2 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Assay, *Testing procedures, *Sensitivity analysis, *Drinking water, bioassay, Water analysis, Secondary wastewater, Activated sludge, Separation techniques, Membrane filters, Humus sludge.

A direct method of preparing water samples for use in Ames Salmonella/microsome mutagenicity assays uses samples filtered through a membrane before mixing with agar to prepare the bottom agar layer for plate incorporation assays. This technique was compared to a procedure of testing dichloromethane liquid-liquid extracts of settled sewage, humus tank effluent, activated sludge effluent and tap water samples. Results showed that in the direct test method, much smaller volumes of test samples are required, while time-consuming, expensive and complex extraction procedures are eliminated. When settled sewage and secondary treated wastewater were used, the direct test method proved more sensitive than the extraction test method because it yielded positive results more often and was not affected by toxic constituents. Although it could not match the sensitivity of the tests on highly concentrated extracts, and may be sufficient for screening drinking water supplies. (Geiger-FRC)
W82-06548

DETERMINATION OF ALDICARB RESIDUES IN WATER BY COMBINED HIGH PERFORMANCE LIQUID CHROMATOGRAPHY MASS SPECTROMETRY,
Environmental Protection Agency, Research Triangle Park, NC.
L. H. Wright, M. D. Jackson, and R. G. Lewis.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 740-747, June, 1982. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Pollutant identification, *Mass spectrometry, *Carbamate pesticides, *High performance liquid chromatography, *Aldicarb, Separation techniques, *Chromatography, Pesticide residues, Water analysis.

A rapid and sensitive method for the determination of aldicarb, aldicarb sulfoxide, and aldicarb sulfone by a method based on combined liquid chromatography/mass spectrometry (LC/MS) is described. Analytical standards were extracted with dichloromethane and dried by passage through a glass wool/sodium sulfate column. After drying, the column was rinsed with hexane; the rinse was combined with the extracts, and the whole sample was reduced to about 0.5 milliliters under a stream of dry nitrogen before reconstitution to 5 milliliters by the addition of hexane. The extracts were refrigerated until LC/MS analysis, when they were reduced to 1.0 milliliters under a stream of liquid nitrogen. Average recoveries were 57% for aldicarb, 110% for aldicarb sulfone, and 101% for aldicarb sulfoxide. MS compares favorably with other detectors in terms of sensitivity, and the selectivity of the MS and minimum cleanup time required are added advantages. (Geiger-FRC)
W82-06549

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

AN INTRODUCTORY STUDY OF SEASONAL VARIATION IN THE AEROBIC HETEROTROPHIC BACTERIAL POPULATION OF THE SAINT JOHN RIVER USING CLASSICAL SYSTEMATICS,
M. J. Chalifour, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 16-23, Tab, Fig.

Descriptors: *Saint John River, *Aerobic populations, *Heterotrophic bacteria, Study, Enzyme activity, Seasonal factors, Alcaligenes, Flavobacterium, Pseudomonas, Zoogloea, Xanthomonas, Chromobacterium, Enterobacteriacae, Growth factors, Isolates, Oxygen levels, Pollutants, *New Brunswick, *Systematics.

Subsurface water samples were collected from the Saint John River in October, February and August, one mile above and one mile below the effluent outflows of a food processing plant and a dairy. Aerobic heterotrophic bacteria were isolated, enumerated and identified where possible. The isolates were also examined for enzyme activity. The temperature and pH of the river water were determined at the time of sampling and the 24 hour mean flow rate between sampling locations was recorded. The fluctuation in the genera of bacteria observed indicated that seasonal factors influenced the bacterial population. Many of the isolates required growth factors; the most common one was cyanocobalamin. The ability to store poly-beta-hydroxybutyrate was prevalent in the summer isolates, rare in the winter bacteria. The predominant bacteria in the winter samples were Alcaligenes, Flavobacterium, fluorescent Pseudomonas and Xanthomonas species. Zoogloea species were dominant in August. Chromobacterium, Enterobacteriaceae and non-fluorescent Pseudomonas, as well as Zoogloea, were predominant in the October samples. (WATDOC)
W82-06559

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,
T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 24-33, Tab, Fig.

Descriptors: *Saint John River, Florenceville Site, *Bacterial study, *Heterotrophic bacteria, Numerical analysis, Isolates, Eutrophication, Taxonomy, Population shifts, Organic loading, Methodology, Water quality, Temperature variations, *New Brunswick.

Seasonal river water samples obtained at the point source of the effluent from the McCain food processing plant have been analyzed for numbers and types of heterotrophic bacteria by numerical taxonomy and for temperature and pH. Bacterial counts varied from 10,000 to 1 million (CFU/ml). Forty per cent of the September river samples required growth factor and 17-32% required unknown growth factors. This growth factor requirement was shown again to be seasonal. The February isolates were more versatile nutritionally and more of the isolates utilized a wide range of substrates. The winter organisms were able to grow well at a wide temperature range in contrast with the September isolates which did not grow at 4 C. The starch discharged by the food processing plant did not produce an increase in starch hydrolyzing bacteria. The samples obtained above and below the point source of the effluent yielded isolates of similar characteristics, whereas the effluent isolates were distinctly different indicating that the effluent bacteria were not retained as a major segment of the river bacterial population. It was concluded that the effluent bacteria were diluted by the river to numbers below detection by the methods employed in this study. (WATDOC).
W82-06560

BACTERIA UNDER THE ICE,
T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 34-42, Fig, Tab.

Descriptors: *Taxonomy, *Numerical analysis, *Bacterial populations, *Ice, *Pollutant Identification, Water quality, Reference strains, Pseudomonas fluorescens, Aeromonas, Derxia, Flavobac-

terium, Effluent clusters, Alcaligenes, Biotypes, Runoff, DNA analysis.

All February isolates which survived the culturing procedures were analyzed by numerical taxonomy. The analysis included reference strains and effluent isolates which rarely clustered with their river counterparts. The clustered strains were identified by classical methods and the identification was supported by DNA analysis. The predominant species found at both river sites were P. fluorescens biotypes B, E and F and Flavobacterium. P. stutzeri as well as other nonspeciated Pseudomonas were also observed. River clusters were identified also as Klebsiella, Aeromonas, Sphaerotilus natans and Azotobacter. The effluent clusters, which contained only strains from the effluent, included Derxia, Aeromonas, Pseudomonas, Alcaligenes and Pseudomonas sp. The data base of the numerical taxonomy made it possible to group strains to simplify the classification and to identify their locations. The bacteria isolated from the river two miles apart showed great similarities and the dilution of the effluent strains indicated that bacteria introduced into the river by the effluent did not become part of the free-floating population downstream. These findings supported the preliminary work of Chalifour and Holder-Franklin. (WATDOC)
W82-06561

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,
C. J. Cormier, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 43-77, Fig, Tab.

Descriptors: *Heterotrophic bacteria, *Meduxnekeag River, *New Brunswick, *Population shifts, *Taxonomy, *Seasonal variations, *Diurnal changes, Heterogeneity, Bacterial species, Pollutants, Genera, Isolates, Cluster analysis, Temperature variations, Aeromonas, Flavobacterium, Pseudomonas, Xanthomonas campestris, Water quality.

Seasonal and diurnal changes in the heterotrophic bacterial community isolated from the Meduxnekeag River at the Environment Canada monitor, Belleville, N.B., were observed in March, July, September and October. A detail of the numerical taxonomy is presented to show the efficacy of using this method to detect population shifts. The variety of species observed in these samples indicated a complexity of the bacterial flora not observed previously. Although temperature is a highly selective environmental parameter, it was shown in this study that a very diverse population was present in September and October in samples taken two weeks apart and at the same temperature. Aeromonas, Flavobacterium and non-fluorescent Pseudomonas were predominant in September, whereas in October owing to the diurnal variation certain species predominated according to sampling time. Beginning at noon, Pseudomonas carophylli, a non-fluorescent organism, and Xanthomonas campestris were preeminent. At early evening, P. fluorescens obtained a clear majority and only two strains of P. carophylli remained. Another shift placed the Flavobacterium in greater numbers by midnight. The March samples demonstrated very low numbers clustering with great heterogeneity in the samples. The shift to fluorescent Pseudomonas observed in other winters at other sampling sites was not seen. A variety of organisms were isolated in July with a slight shift to the more fermentative groups. Diurnal variation was not as apparent in March and July.(WATDOC)
W82-06562

DIURNAL VARIATIONS OF THE HETEROTROPHIC BACTERIA IN THE SEDIMENT AND WATER OF A SMALL WOODLAND STREAM,
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 78-89, Tab, Fig.

Descriptors: *Heterotrophic bacteria, *Dunbar River, *Bacterial enumeration, *Diurnal variations, Water quality, Sediment populations, Water populations, Mathematical analysis, Taxometric analysis, Physico-chemical parameters.

Diurnal variation in certain biological, physical and chemical parameters was observed in water samples collected from the Dunbar River, a pristine woodland stream, periodically during a 56-hour period in August. A reduction in 02, pH, C and P was accompanied by a decrease in chlorophyll and bacterial counts in water and sediment incubated at 20 C. As darkness descended, the turnover time took a noticeable upswing followed by buildup in N03 and eventual peaking of the Vmax. Dusk also brought an increase in sediment counts at 5 C. Another peak was observed in these sediment psychrophiles at dawn. Species varied somewhat- an increase in fermentative enterics was observed during the day, with the converse true of the aerobic, non-fermentative group. The modest cycling of species in ;this study was also observed in the Meduxnekeag in a previous summer study. The factor analysis demonstrated the clear differences in the sediment and water populations. Links between these populations are only speculative from the results reported here. (WATDOC)
W82-06563

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 90-98, Tab.

Descriptors: *Meduxnekeag River, *Dunbar River, *Nutrient transformations, *Population shifts, Aquatic ecosystems, Sediment samples, Heterotrophs, River isolates, Pseudomonas fluorescens, Delafieldi, Acidovorans, Cytophaga fermentus, Taxonomy, *New Brunswick.

The Meduxnekeag and Dunbar rivers, in addition to having differing water uses and physico-chemical parameters, show large differences in sediment structure. The Meduxnekeag has a dark grey silty mud, whereas the Dunbar has a coarse gravel. The sediment counts are always at least one order of magnitude greater than the river counts. Counts in the Meduxnekeag sediment are about ten times higher than counts in the Dunbar sediment. Correlations between total heterotrophic counts in sediment and water are insignificant. There is thus little overall interchange in numbers. The Meduxnekeag sediment is highly typical of these river systems in lacking fluorescent pseudomonads. The Dunbar sediment harbours twice as many obligate aerobes as does the overlying water. The sediment populations in both rivers accumulate more PBH than the water populations, have a lower frequency of anaerobiosis and fermentation, are more mesophilic and less proteolytic and lipolytic. Four factors express the variability in the Meduxnekeag populations. Only three factors emerge for the Dunbar populations. These three factors all have a strong oxidative bias. Oxidative bacteria are believed to reside in the Dunbar sediment and possibley seed the overlying water. These populations are more affected by changes in water parameters than the water populations. Fermentative bacteria are believed to reside in the Meduxnekeag sediment and seed the overlying water. The Meduxnekeag sediment populations are largely unaffected by changes in the physico-chemical nature of the water. Viable counts in the Meduxnekeag water are influenced primarily by rainfall and organic C. Sediment populations are only effected by NH4. Ammonia is the key variable influencing both sediment and water counts in the Dunbar. These differences between sediment populations are attributable largely to the difference in sediment structure. (WATDOC)
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,
Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131, 1981. 347 p 107 Fig, 31 Tab, 143 Ref.

Descriptors: *Canada, *Eutrophication, *Nutrient reduction, *Loading estimates, Phosphorus, Chlorophyll, Oxygen depletion, Diagnosis, *Oliogotrophic lakes, Secchi transparency, Hydraulic load, Lake Classification, Pollutant identification.

The OECD International Programme on Eutrophication has been designed for cross sectional comparison of lakes to provide management with simple tools to evaluate nutrient reduction, particularly phosphorus, necessary to alleviate excessive eutrophication. The scope of the Canadian programme was to test the applicability of the overall OECD results on a set of data not included in the original elaboration with three main objectives in mind; clarification of the extent to which lakes of an unspecified nature exhibit statistical properties similar to the OECD lakes, clarification and identification of the limits of transferability, identification of conditions which need further evaluation. The Canadian lakes data base represents a collection of information from personal communication with various workers involved in major limnological projects as well as that contained in the literature. It has been subdivided into seven major geographical regions which are treated separately. In a diagnostic sense, the majority of Canadian lakes tested show statistical behaviour similar to that of the OECD lakes, particularly in regard to the relationships between annual mean chlorophyll and annual mean phosphorus, annual mean phosphorus and flushing corrected inflow phosphorus concentration, and annual mean chlorophyll and flushing corrected inflow phosphorus concentration. However, application of the results for predictive purposes requires care. A number of limiting conditions were identified under which applicability and transferability of OECD results are either questionable or should be done with utmost care. These include situations where: euphotic zone depth/mean depth is substantially greater than one; hydraulic load is high (q sub s is greater than 50 m/y). flushing rate is more than twice/year and/or lakes with irregular flushing regimes either seasonally or over consecutive years; high mineral turbidity or a high degree of humic staining exists; N/P ratios are greater than 5 and/or P exceeds 100 mg/cu m; phosphorus is relatively inert (e.g. as apatite) or internal loading is substantial and dynamic equilibrium has not been attained as in the case of increasing or decreasing nutrient loads. (WATDOC)
W82-06566

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 7C.
W82-06567

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,
Canada Centre for Inland Waters, Burlington (Ontario).
A Mudroch.
Scientific Series No 122, 1981. 44 p, 14 Fig, 35 Tab, 106 Ref.

Descriptors: *Great lakes, *Coastal lake marshes, St. Lukes, Dover, Cootes Paradise, Balmoral, Big Creek, Walpole Island, *Chemical composition, *Trace elements, Nutrients, Water quality, Marsh

water, Sediments, Geochemistry, Wetlands, Macrophytes, Metals, Nitrogen, Phosphorus, *Pollutant identification, *Lake Erie, *Lake Ontario, *Lake St. Clair.

Six marshes adjacent to the Great Lakes were investigated to evaluate their beneficial and/or detrimental effects on the water quality of the lakes. The nutrient (N and P) and trace element (Pb, Cu, Cr, Ni, Cd, As and Hg) concentration changes in marsh water, the geochemistry of sediments, and the nutrient and trace element uptake by marsh plants and their biomass production were investigated. The marsh water retained pH values of between 7.8 and 8.4, and the sediments were submerged mineral soils with pH ranging between 6.9 and 7.2 with more than half of the particles in the silt size (2-63 micro m) fraction. Concentrations of nutrients and trace elements in march water and sediment were compared with those found in lakes Ontario and Erie. Large differences were observed between the concentrations of various forms of nitrogen present in marsh, lake and stream water. Most of the nitrogen present in the marsh water was in the form of organic nitrogen. Dissolved oxygen concentration in the marsh water during summer months remained relatively high (4-8 mg per L). The nutrient input to the marshes affected the aboveground biomass production and the species composition in the marshes. Submerged macrophytes accumulated higher concentrations of Pb, Cr, Ni, Cd, Co and Cu than the emergent macrophytes. All of the marshes studied showed a high capacity to retain nutrients and metals. The degree of this retention depended on the hydrological regime and species composition in the marsh. It was calulated that a complete discharge of the marshes into the adjacent lakes would contribute only negligible quantities of N Nd P in relation to the loadings from other sources. (WATDOC)
W82-06570

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
For primary bibliographic entry see Field 5B.
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 71, 1981. 9 p, 1 Fig, 7 Tab, 8 Ref.

Descriptors: *Polychlorinated biphenyls, *Pollutant identification, *Sediments, Dixon procedure, Webb-McCall procedure, Comparable levels, Extraction, Organics, Contamination, Quality control, Homogeneity, Interlabratory studies, Data collections.

This study describes an interlaboratory comparison of the analysis of polychlorinated biphenyls (PCBs) (a 1:1 mixture of Aroclors 1254 and 1260) at concentrations of about 1 ppm in 10 to 20 spiked wet sediment. The average coefficient of variation (16.2%) of the present study is very similar to previously reported results in other interlaboratory PCB studies at comparable levels. The variation of results among laboratories in this study appears to be due to the variation in quantitation methods more than to the variation in extraction and cleanup procedures. The laboratories that used the Webb-McCall quantitation procedure gave better accuracy and precision than those that used other quantitation procedures. (WATDOC)
W82-06575

WATER QUALITY OF THE UPPER NIAGARA RIVER, 1975 AND 1979,
Canada Centre for Inland Water, Burlington (Ontario).
K. W. Kuntz, and C. H. Chan.
Scientific Series No 129, 1982. 22 p, 13 Tab, 7 Fig, 12 Ref.

Descriptors: *Upper Niagara River, Tonawanda Channel, Chippawa Channel, Quality control, *Chemical analysis, Statistical data, Nutrients, Trace metals, Microbiology, Organic contaminants, Ion concentration, *Pollutant identification.

In 1975 and 1979, surface water samples were collected on the Upper Niagara River for a wide variety of analyses including nutrients, major ions, trace metals, toxic organic contaminants and microbiological parameters. Results indicated higher concentrations of nutrients, trace metals and bacteriological parameters in the Tonawanda Channel than in the Chippawa Channel of the Upper Niagara River. Major ion Concentrations have remained relatively constant between 1975 and 1979. Nutrients data remain unchanged except for an increase in nitrate nitrogen and a decrease in particulate organic carbon. Total iron concentrations and total and fecal coliform counts in the Tonawanda Channel frequently exceeded water quality objectives of the 1972 Canada/United States Great Lakes Water Quality Agreement. (WATDOC)
W82-06576

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Ouellet.
Environment Canada, Inland Waters Directorate, Quebec, Canada, Scientific Series No 123, 1981. 37 p 99 Ref, 4 Tab, 14 Fid.

Descriptors: *Lac Laflamme, *Quebec, *Paleolimnology, *Geochemistry, *Geochronology, Fallout, *Air Pollution, *Stratigraphic distribution, Precipitation, Acid rain, Acidification, *Sediments, Ecosystems, Plankton, Water quality, *Pollutant identification.

The present paleolimnological study, which deals essentially with the geochemical and biological characteristics of the most recent sediments of Lac Laflamme, is part of an integrated research program recently initiated by Environment Canada. This research program is aimed at achieving a better understanding of the effects produced on the environment by the fallout of pollutants transported over long distances in the atmosphere. This report deals with the geochronological and geochemical aspects, and with the composition and abundance of the fossil groups of algae and crustaceans over time. The stratigraphic increase in 137Cs, Na, Cu S, Ca, Hg, Ni, Pb and Zn, beginning primarily in the levels corresponding to the 1940s, reflects the quantities of these elements released into the atmosphere by various anthropogenic activities. However, for the same period of time, there is a slight decline in A1 and Ca levels in the sediments of Lac Laflamme, which may be attributable to the greater mobility of these elements as a result of the effects of precipitation acidification. To date, the high capacity of the loose sediments in the lake for ion exchange has prevented acifification of the lake's waters, which still maintain a pH level of approximately 6.1. This neutralization capacity has thus enabled the paleocommunities of algae and cladocerans to remain in equilibrium over the past several hundred years. (WATDOC)
W82-06577

EVALUATION OF A SYSTEM TO AUTOMATICALLY SAMPLE ZOOPLANKTON FROM THE DISCHARGE OF DAMS,
Cooperative Fishery Research Unit, Amherst, Massachusetts
R. A. Rosen.
Water Resources Bulletin, Vol 18, No 1, p 147-152, February, 1982. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Zooplankton, *Measuring instruments, Dams, Flow discharge, Crustaceans, *Sampling, Water quality, *Automatic sampling, *Massachusetts, Connecticut River, Holyoke Pool.

Although zooplankton are excellent biological indicators of water quality, they can be difficult or time consuming to routinely monitor. Swanson proposed a means to automatically sample plankton from the intake water at dams in 1965. However, although this system can reduce or nearly eliminate the labor involved in an extensive sampling program and can sample at any time for any duration, it has received only modest use. Two samplers were operated continuously for more than two years to monitor the crustacean zooplankton influx into and discharge from the Holyoke Pool of the Connecticut River in Massachusetts. The sampling efficiency of these two samplers was evaluated and compared to that of a conventional towed-net sampler. The automatic samplers efficiently sampled most species and size classes of crustacean zooplankton in a similar, but not consistently identical, manner to the towed-net plankton sampler. The automatic sampler captured the smallest sized zooplankton more efficiently than the largest representatives. Mesh selection and sampler avoidance exerted different influences on the automatic samplers and on the towed-nets. The study results indicate that direct use of the results from automatic samplers, individually or in comparison with results from other automatic samplers, provides a valid and accurate assessment of plankton density and species composition in waters passing through a dam. (Carroll-FRC)
W82-06628

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,
Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 2K.
W82-06630

RIGHT PLACE, TIME AND TECHNIQUE: RIGHT SAMPLE,
ISCO, Inc., Lincoln, NE.
D. M. Grant.
Water-Engineering and Management, Vol 129, No 7, p 28-32, June, 1982. 3 Fig, 3 Tab.

Descriptors: *Sample preservation, *Water sampling, *Sampling, *Pollutant identification, Wastewater analysis, Sample preparation.

The importance of proper sampling techniques, representative samples, and sample preservation in water and wastewater analysis are emphasized. Reliable analytical data are vital in water pollution control in the key areas of policy planning, program planning, and enforcement. The best method for obtaining the most representative sample depends on flow data, character and variability of the source, and the objective of the program. Two types of samples are discrete (grab) and composite. Discrete samples are preferred when the source does not flow continuously, when extreme conditions must be detected, when the source is relatively constant, and when time variations are needed. Composite samples may be simple, flow-proportional, or sequential. They give a good indication of average characteristics. Types of sample gathering systems are described: mechanical, forced flow,

and suction lift. Frequency of sampling depends on the variability of the source. Volume depends on the type of analysis. A table lists the required volume, type of container, preservative measures, and recommended holding time for about 50 wastewater constituents. Generally, the minimum volume for discrete samples is 100 ml; for individual aliquots of composite samples, 25 ml, with a total composite volume of 4 liters or more. Refrigeration is the most common sample preservation method to prevent chemical and microbiological activity during storage. Obviously, immediate analysis is preferable to storing samples. (Cassar-FRC)
W82-06642

ALGAE AND CRUSTACEANS AS INDICATORS OF BIOACTIVITY OF INDUSTRIAL WASTES,
Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh, K. M. Duke, and R. B. Foster.
Water Research, Vol 16, No 6, p 879-883, June, 1982. 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Industrial wastes, *Bioindicators, Toxicity, Water pollution sources, Bioassay, Pulp wastes, Pulp and paper industry, Algal growth, Crustaceans, Laboratory studies.

The effects of 10 industrial waste samples on Selenastrum capricornutum, a freshwater alga, and Skeletonema costatum, a marine alga, were studied in laboratory bioassays. Effects on growth of these algae were compared to toxicity to crustaceans that are considered to be pollutant-sensitive species: Daphnia magna (freshwater) and Mysidopsis bahia (marine). The effluents tested included wastes from three paper mills, two textile mills, two fiber plants, an oil refinery, a chemical manufacturing plant and a tannery. None was strongly inhibitory to algal growth, but all stimulated growth at low concentrations. No waste type appeared to be either more or less bioactive than any other. From the results it was concluded that algal growth bioassays with complex industrial wastes need not be conducted for longer than 4 days. Daphnia magna and Mysidopsis bahia were less sensitive to the wastes than were the algae. Algal data were valuable in calculating the 7-day, 10-year, low flow rates required for safe disposal of the effluents. Algal data indicated need for greater dilution and thus afforded a greater margin of safety than did animal data. (Baker-FRC)
W82-06654

DESIGN AND OPERATION OF A COLORIMETRIC DETECTOR CONTROLLER,
Natal Univ., Durban (South Africa).
R. H. Turnbull.
Water Research, Vol 16, No 6, p 801-808, June, 1982. 10 Fig, 3 Tab, 2 Ref.

Descriptors: *Design criteria, *Colorimetry, Water analysis, Water quality, Measuring instruments, *Pollutant identification.

This report covers the design and operation of a suitable colorimeter based on the ADMI color method. The colorimetric detector controller is suitable for industrial applications with a color detection range of 100 ADMI units. The design is based on the measurement of the response in the blue, green, and red light bands covering the 400-700 nm spectrum. The fourth detector is used for detecting ferric ions in the range of 0-5 mg/liter, by detecting the color complex ferri-ferro-cyanide. With decreasing water quality, shorter light path lengths will be required, with corresponding reduction in sensitivity. (Baker-FRC)
W82-06656

A WATER QUALITY INDEX FOR LAKE BEACHES,
Eco-Recherche Ltd., Pointe-Claire (Quebec).
For primary bibliographic entry see Field 5G.
W82-06660

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,
Geological Survey, Tallahassee, FL.. Water Resources Div.
B. G. Waller, and W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-194960, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-3, 1982. 70 p, 23 Ref, 20 Tab, 27 Ref.

Descriptors: *Water quality, *Canals, *Wastewater, *Environmental effects, Land use, Urban runoff, Pollutants, Water sampling, Sediments, Nutrients, Pesticides, Water analysis, Data collections, *Florida, Broward County.

An intensive water-quality monitoring program was started in 1969 to determine the effects of man-induced contaminants on the water quality in the primary canal system of eastern Broward County, Florida. This report covers the first 6 years of the program and provides a data base that can be used to compare future changes in water-quality conditions. Most data indicate that beyond the small seasonal fluctuation in constituent level, the greatest adverse effect on the quality of water is caused by discharge of sewage and treated sewage effluent to the canals. The areas affected by sewage have greater concentrations of macronutrients, trace metals, and pesticides than unaffected areas. Major-ion concentrations were affected only by season and local lithology. Over the 6-year study a gradual decrease in macronutrient concentration and an increase in dissolved oxygen have occurred. This improvement in water quality is attributed to a decrease of sewage discharge into canals and better treatment of sewage effluents. (USGS)
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06688

ORGANOCHLORINE RESIDUES IN FISH FROM LAKE MJOSA IN NORWAY,
Institutt for Energiteknikk, Kjeller (Norway).
E. M. Brevik.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 5, p 679-680, May, 1981. 1 Tab, 6 Ref.

Descriptors: *Pesticide residues, *Fish, *Chlorinated hydrocarbons, Pollutant identification, Air pollution, Polychlorinated biphenyls, DDT, Organic compounds, Hexachlorobenzene, *Lakes, Aquatic life, Norway, Mjosa Lake.

Levels of total DDT, polychlorinated biphenyls (PCB), and HCB in livers of lagesild (Coregonus albula) from Lake Mjosa, Norway, did not change significantly, according to annual sampling from 1974 to 1979. Total DDT ranged from an average of 0.7 to 3.1 ppm (fat weight basis); PCBs, 1.5 to 6.7 ppm; and HCB, 0.11 to 0.29 ppm. These freshwater fish samples contained only one fifth the levels of organochlorine compounds normally found in ocean fish from relatively un-contaminated fjords and open ocean. (Cassar-FRC)
W82-06697

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,
Missouri Univ., Kansas City. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06702

ON THE DETECTION OF MUTAGENIC/CARCINOGENIC ACTIVITIES IN WATER WITH THE SALMONELLA/MICROSOME TEST (AMES TEST)(ZUM NACHWEIS MUTAGENER/KANZEROGENER AKTIVITATEN IN WASSERN MIT DEM SALMONELLA/MIKROSOMEN-TEST (AMES-TEST)),
Mainz Univ. (Germany, F.R.). Hygiene Inst.
E. H. Pfeiffer.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 39-41, January, 1982. 16 Ref. English summary.

Descriptors: *Drinking water, *Ames test, *Carcinogens, *Pollutant identificaion, *Mutagens, Testing procedures, Water quality, Pollutants, Salmonella, Toxins, Bioindicators.

The Ames test is described and its use for detecting mutagenic and carcinogenic substances in various waters is evaluated. The use of this test to identify carcinogens rests upon the assumption that a correlation exists between the mutagenic and carcinogenic effects of a given substance. However, this relationship appears to be restricted to compounds that react directly with DNA or that can be transformed metabolically into electrophilic alkylating substances. It is estimated that 75-90% of known carcinogens in the Ames test are also mutagens, and false negatives and positives each account for about 10% of substances tested. The Ames test is usually applied to newly developed chemicals, and its use in complex substances such as drinking water and dust opens up a new field. The test can indicate the presence of harmful substances in drinking water and point to multiplication and summation effects in the presence of certain other substances. Substances with antagonistic or inhibitory effects may affect the result, and the possibility also exists that a substance may not be present in a concentration high enough to give a positive result. Thus the usefulness of the Ames test may be affected by the chemical preparation of the water sample for the test. Nevertheless the Ames test can be used to screen water for possible mutagenic and/or carcinogenic substances, after which further mutagenicity tests (e.g. cell culture) should be conducted. Animal experiments are necessary to test for carcinogenicity. (Gish-FRC)
W82-06715

MULTIPLE POTENTIOMETRIC SYSTEM FOR CONTINUOUS DETERMINATION OF CHLORIDE, FLUORIDE, NITRATE, AND AMMONIA IN NATURAL WATERS,
Warsaw Univ. (Poland). Dept. of Chemistry.
M. Trojanowicz, and R. Lewandowski.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 308, No 1, p 7-10, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Monitoring, *Water analysis, *Potentiometers, *Pollutant identification, *Chlorides, *Fluorides, *Nitrates, *Ammonia.

Chloride, fluoride, nitrate, and ammonia were simultaneously determined in natural waters using a flow-through system suitable for routine monitoring. Sensors used were solid state chloride and fluoride electrodes, a nitrate PVC membrane electrode with solid silver contact, and a gas-sensing ammonia ORION 95-10 electrode. The incoming samples were segmented by air and mixed with appropriate buffering solutions before entering the measuring cells. The method was tested over the concentration ranges (in ppm) of 30-150 for Cl, 0.08-0.4 for F, 5-20 for nitrate, and 0.05-0.5 for ammonia. The system was used to monitor tap water for 6 months and to monitor river quality at Warsaw for 2 months. Accuracy was about + or - 10%. Time for analysis was 15 min. (Cassar-FRC)
W82-06718

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,
State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
For primary bibliographic entry see Field 5C.
W82-06721

COMPARISON OF FILTRATION TECHNIQUES FOR SIZE DISTRIBUTION IN FRESHWATERS,

Edinburgh Univ. (Scotland). Grant Inst. of Geology.
D. P. H. Laxen, and I. M. Chandler.
Analytical Chemistry, Vol 54, No 8, p 1350-1355, July, 1982. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Filtration, *Natural waters, Water analysis, Particle size, Filters, Screens, Separation techniques, Particulate matter, Suspended solids, Trace metals, Water pollution control, Sample preparation.

A more systematic insight into the filtration of freshwaters was sought with emphasis on the following points: to compare depth filters (Sartorius) and screen filters (Nuclepore) of different nominal pore size with a view toward determining their respective suitability for size distribution studies; to compare filtration using stirred and unstirred samples, the former being designed to prevent or minimize accumulation of material on the filter; to compare size distributions based on immediate filtration in the field with filtration performed several hours later in the laboratory; and to compare filtration through glass fiber filters with membrane filters. It was concluded that screen filters (Nuclepore) provided more accurate size fractionation, so long as the filter was not allowed to clog. No benefit was derived from stirring the sample during filtration. Field filtration was necessary to achieve the most reliable size fractionation. The criteria used to evaluate filtration properties are iron and manganese filtrate concentrations and scanning electron microscope examination of the filtered particulates. (Baker-FRC)
W82-06731

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,

Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
G. Langeland.
Applied and Environmental Microbiology, Vol 43, No 5, p 1111-1115, May, 1982. 3 Tab, 21 Ref.

Descriptors: Wastewater facilities, *Bacteria, Salmonella, Human diseases, Oslo, *Norway, Sludge, Occupational hazard, *Pollutant identification.

The presence of Salmonella spp. in the working environment and sewage sludge at three sewage works in Oslo was investigated. Ten series of samples were taken at intervals of 2 months from April 1979 to November 1980. The last three series also included samples from plant influent and effluent. Salmonella bacteria were isolated from surfaces and areas with hand contact in the treatment plant, from floor surfaces in the changing rooms, and in one case from floor surfaces in an eating room. The sewage sludge contained from 140 to 140,000 Salmonella spp per 100 g dry weight. Raw and treated sewage contained an average of 130 and 3 of these bacteria per 100 ml, respectively. There were poor correlation between the pattern of serotypes isolated from the sewage works and the patterns of those which were registered among the population of Oslo during the investigation. Neither enteropathogenic bacteria nor parasite eggs were found in fecal samples from employees at the plant. The health aspects of the situation are considered. With the exception of Salmonella paratyphia-B, the Salmonella strains found are unlikely to cause disease after oral intake at these levels. However, if contamination of a suitable foodstuff occurs, multiplication of these Salmonella strains could reach the level required for an infective dose. (Baker-FRC)
W82-06734

EVALUATION OF CELL LINES AND IMMUNOFLUORESCENCE AND PLAQUE ASSAY PROCEDURES FOR QUANTIFYING REOVIRUSES IN SEWAGE,

Utah State Univ., Logan. Dept. of Biology.
D. N. Ridinger, R. S. Spendlove, B. B. Barnett, D. B. George, and J. C. Roth.
Applied and Environmental Microbiology, Vol 43, No 4, p 740-746, April, 1982. 6 Tab, 25 Ref.

Descriptors: *Viruses, *Wastewater, Cultures, Water pollution control, Water analysis, Water quality, *Reoviruses, *Pollutant identification.

A versatile assay method is needed for the more than 100 different viruses excreted by humans into sewage. Reoviruses have been suggested for use in developing such an assay technique. The sensitivities to reoviruses of 12 continuous cell lines were compared. Three of these 12 cell lines were then compared using unserotyped reovirus precipitated from sewage by protamine sulfate. The most sensitive cell line was subsequently used in a comparative study of the plaque and the ICC assay procedures. Madin-Darby bovine kidney (MDBK), rhesus monkey kidney (LLC-MK2) and human embryonic intestinal (intestinal 407) cells were most sensitive to reovirus types 1, 2, and 3 respectively. MDBK cells were more sensitive than LLC-MK2 and Buffalo green monkey (BGM) cells to sewage-isolated, protamine-precipitated reoviruses which had not been serotyped and had no previous cell contact. Sewage-isolated, protamine-precipitated reoviruses were also used in conjunction with MDBK cells in a comparative evaluation of immunofluorescent cell count and plaque assay procedures. The immunofluorescence assay is more sensitive and more rapid than the plaque assay. Reoviruses in excess of 10000/liter of raw sewage were detected by the immunofluorescent cell count assay. Reoviruses were concluded to possess the characteristics required for water pollution test viruses. MDBK cells are sufficiently sensitive to reoviruses to permit reovirus detection in < 24 hr. (Baker-FRC)
W82-06735

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,

Kurita Water Industries Ltd., Yokohama (Japan).
S. Nishikawa, S. Sakai, I. Karube, T. Matsunaga, and S. Suzuki.
Applied and Environmental Microbiology, Vol 43, No 4, p 814-818, April, 1982. 9 Fig, 1 Tab, 7 Ref.

Descriptors: Water analysis, *Microbiological studies, Water treatment, Wastewater treatment, Water pollution control, Bacteria, *Pollutant identification.

A new electrode system using a fuel cell-type electrode, a redox dye, and a porous acetylcellulose membrane filter for trapping microorganisms is described. The electrode was constructed from a platinum anode, a silver peroxide cathode, and a membrane filter for retaining microorganisms. The principle of cell number determination was based on sensing with the electrode a redox dye reduced by the microorganisms. Sample solutions containing microorganisms were membrane filtered, and the resulting filter containing microbial cells was attached to the surface of a platinum anode. The electrode was immersed in phosphate buffer solution containing a redox dye, and the current generated was measured. The response time of the electrode system was 10 to 20 minutes, and the current generated was proportional to cell populations above 10,000 cells/ml. (Baker-FRC)
W82-06743

COMPARISON OF FOUR MEMBRANE FILTER METHODS FOR FECAL COLIFORM ENUMERATION,

Ontario Ministry of the Environment, Rexdale.
J. E. Pagel, A. A. Qureshi, D. M. Young, and L. T. Vlassoff.
Applied and Environmental Microbiology, Vol 43, No 4, p 787-793, April, 1982. 8 Tab, 17 Ref.

Descriptors: *Membrane processes, *Coliforms, Membrane filters, Filters, Membranes, Bacteria, Water analysis, Water quality, Water pollution control, *Pollutant identification.

The relative performance of four membrane filter (MF) enumeration methods for fecal coliforms was evaluated by determining performance characteristics. Three pure cultures of fecal coliforms were used for the study: E. coli 104, E. coli B, and Klebsiella pneumoniae. Recovery accuracy with pure cultures ranged from 89 to 100% for m-FC, mTEC and m-FC2 methods, but was less than 60% for the MacConkey membrane broth method. These figures dropped by about 40 to 55% when the cultures were subjected to temperature stress. Nearly 800 colonies were verified to determine specificity. False positive colonies occurred most frequently (18%) with the m-FC2 method, whereas false negative colonies were most common on MacConkey membrane broth (26%). In counting range experiments using a variety of samples, the highest upper counting limit was 130 colonies per filter with the mTEC procedure. Recovery comparisons were based on more than 130 samples, including raw surface waters, raw sewage, and chlorinated and unchlorinated sewage effluents. Recoveries were generally higher with the m-FC2 and mTEC methods. However, on m-FC2, growth of nontarget background organiams was also higher in most cases. Highest recoveries from chlorinated sewage effluents were obtained by th mTEC method, and the addition of a similar resuscitation period to the m-FC procedure improved fecal coliform recovery from such samples. The best overall performance for fecal coliform enumeration was obtained with the mTEC method, giving high recovery and low levels of background colonies, good specificity and accuracy, and high upper counting limit. This procedure also offers the advantage of enumerating. E. coli within 24 hr. (Baker-FRC)
W82-06744

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,

University of West Florida, Pensacola. Dept. of Biology.
M. T. MacDonell, and M. A. Hood.
Applied and Environmental Microbiology, Vol 42, No 3, p 566-571, March, 1982. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Estuaries, *Bacteria, Coastal waters, Gulf Coast, *Estuarine environment, Marine waters, Nutrients, Vibrio, Aeromonas, Pseudomonas, Alcaligenes, Microorganisms, Ultramicrobacteria, *Alabama, Perdido Bay.

The warm waters of a Gulf Coast estuary were examined for the presence of ultramicrobacteria, and an attempt was made to isolate these organisms and to phenotypically characterize them. Water samples were taken from about 10 cm below the surface at four sites in Perdido Bay, Alabama, during April-June 1981. These sites were less impacted by human actvities and represented a wide range of salinities. Visual confirmation of bacteria in the water was made through fluorescent microscopy. Of the 27 isolates, 89% were initially incapable of growth in any of several full strength nutrient rich broths. Further more, no isolate was capable of a single positive reaction in full strength biochemical media. Several dilutions of various media were tried until the optimum concentration of an eight-fold dilution was obtained, which permitted the organism to grow while providing enough indicator for classical color reactions to be noted. The organisms were being inhibited by the rich nutrient concentrations. Adaptation to a nutrient-rich medium was accomplished and was accompanied by a pronounced increase in size. The majority of the isolates were oxidase positive and catabase positive. All were gram negative, and with a single exception, all were motile. With three exceptions every isolate was string test positive. Some phenotypic environmental Aeromonas spp. are also able to produce positive string test reactions. Because of the high incidence of positive reactions produced by the Perdido Bay isolates, the string test may be a meaningful characteristic, although the significance of the test is unclear at this time. The abundance and the nutritional requirements of the ultramicrobacteria found imply that they represent a class of microorganisms which have successfully adjusted to poor nutrient conditions. (Baker-FRC)
W82-06747

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,
Wisconsin Univ., Eau Claire. Dept. of Biology.
C. A. Meadows, and B. H. Snudden.
Applied and Environmental Microbiology, Vol 43, No 4, p 953-954, April, 1982. 2 Tab, 5 Ref.

Descriptors: *Enterobacter, *Water analysis, Human diseases, Diseases, Bacteria, Yersinia enterocolitica, Rivers, Bacterial analysis, Water pollution effects, Public health, Seasonal variations, *Wisconsin, Chippawa River basin.

A total of 303 water samples were collected between March 1978 and May 1979 in the lower Chippewa River drainage basin, including the river, tributary streams, and storm sewer outflows. Samples were tested for Yersinia enterocolitica, which causes serious gastrointestinal illness in humans. Selective media included MacConkey-Tween 80 agar and Y-M agar. A new method of isolation was developed. Fecal coliform tests demonstrated a considerable variation in water quality at sample sites. Fecal coliforms counts increased in spring and summer and decreased in winter. Woodland streams had lower coliform counts than polluted urban storm sewer effluent or streams which were subject to agricultural runoff. Of the 303 water samples, 78 had greater than 200 fecal coliforms per 100 ml sample. Y. enterocolitica occurred in 25 samples, 22 of which were from rural areas and 3 from urban areas. No common source was evident. Twenty-four of the isolates were obtained with the anaerobic-aerobic technique, and one was obtained with the Y-M agar plate technique. A seasonal variation in Y. enterocolitica occurrence was noted, with only one isolation being recorded outside of the period from November through April. The ability to withstand low temperature was evident. In general Y. enterocolitica was isolated more frequently in the winter season. (Baker-FRC)
W82-06751

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W82-06752

USE OF HOECHST DYES 33258 AND 33342 FOR ENUMERATION OF ATTACHED AND PLANKTONIC BACTERIA,
Naval Research Lab., Washington, DC. Environmental Sciences Div.
J. H. Paul.
Applied and Environmental Microbiology, Vol 43, No 4, p 939-944, April, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: Water analysis, *Bacteria, Measuring instruments, Dyes, Water quality, Acridine orange, Bacterial analysis, *Pollutant identification.

The bisbenzimide dyes Hoechst 33258 and 33342 are examined as stains for epifluorescent enumeration attached and free-living bacteria, attached to smooth surfaces and in natural waters. The method has distinct advantages over acridine orange (AO) staining when enumerating bacteria on surfaces which bind this dye. The presence of greater numbers of autofluorescent particles in natural water samples when viewed in the blue excitation wavelengths required for AO may also cause an overestimation of bacteria during AO counting. The use of DNA-specific stains with UV excitation such as the Hoechst dyes 33258 and 33342 and DAPI can ameliorate this problem. Cultures of estuarine bacteria gave identical counts when stained with Hoechst 33258 or AO, whereas natural populations of aquatic bacteria gave 92 to 98.5% of the acridine orange counts. (Baker-FRC)
W82-06754

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,
Cawthron Inst., Nelson (New Zealand).
L. W. Belser, and E. L. Mays.
Applied and Environmental Microbiology, Vol 43, No 4, p 945-948, April, 1982. 2 Tab, 14 Ref.

Descriptors: *Nitrification, *Bacteria, *Sediments, Soils, Oxidation, Ammonium, Microbiological studies, Biomass, *Pollutant identification.

A simple method for measuring maximum activities of indigenous ammonium oxidizer populations was applied to a number of soils and intertidal sediments. A shaken soil or sediment slurry was incubated, and the second step of nitrification, nitrite oxidation, was inhibited by chlorate. Under these conditions the rate of ammonium oxidation was equal to the rate of nitrite accumulation. Nitrapyrin, a specific inhibitor of nitrification, was added during the incubation to demonstrate that nitrite was produced from autotrophic ammonium oxidation. The most probable number (MPN) counts ranged between 150 to 3000 cells/gram in sediments and between 4400 to 19000 cells/g in soils. These counts were only 0.1 to 5.0% of the estimated populations that would be needed to produce the observed activity. Similar efficiency calculations were made for data already in the literature, and these calculations gave much higher percentages. Thus it was concluded that for the soils and sediments studied, the MPN counting technique greatly underestimated the populations present and that the efficiency calculation could be used as a counting efficiency index. (Baker-FRC)
W82-06755

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,
Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, C. P. Gerba, and V. C. Rao.
Applied and Environmental Microbiology, Vol 43, No 3, p 731-733, March, 1982. 3 Tab, 10 Ref.

Descriptors: *Viruses, *Public health, Toxicity, Wastewater, Settling basins, Raw wastewater, Water analysis, Water quality, Water pollution control, Pollutant identification, Filtration, Centrifugation.

The widespread use of tissue cultures for virus assays requires that cytotoxicity of virus concentrates be minimized. The reduction of cytotoxicity in virus concentrates from environmental samples was accomplished through high-speed centrifugation and by filtration of the samples through positively charged depth filters. The level of toxicity reduction depended on the type of sample used. Water samples studied included those from raw and treated wastewater and from pond sediments. Of the various treatments for reducing cytotoxicity of sewage concentrates, filtration through positively charged depth filters (Zeta-plus, type 50D) was the most effective and reduced the toxicity in 24 of 25 samples tested. The type 5S filter, which has a larger pore size, was much less effective. The negatively charged type 50D and Millipore types GS and HA were also less effective than the 50S filter. Centrifugation at 34,000 x g for 1 hr was the second most effective treatment, with four of six samples showing improvement. Centrifugation at 8,500 x g for 1 hr improved 37% of the samples tested. Treatment with XAD-2 resin columns improved 6 of 11 samples. Freon treatment was the least effective technique, with only 1 of 15 samples improving. Concerning the degree of toxicity reduction, filtration through 50S filters gave 1.2 to 4.4-fold reductions in cytotoxicity. Generally, as the degree of cytotoxicity in the original sample increasd, the reduction in toxicity by 50S filtration decreased. Centrifugation of concentrates from sewage pond sediments at 8500 x g for 1 hr followed by assay of the supernatant revealed a 3.4 fold decrease in toxicity. Whether a treatment which reduces cytotoxicity also reduces the number of infectious virus particles in the sample was also investigated. The 50S filters removed more than 99.9% of the Escherichia coli from suspensions containing 10,000 cells per ml of 0.05 M glycine with or without tryptose phosphate broth or beef extract, but no appreciable loss of virus particles was seen. (Baker-FRC)
W82-06757

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,
Calgary Univ., Alberta. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06770

APPLICABILITY OF LIGHT ABSORBANCE AS A MEASURE OF OGANIC CARBON IN HUMIC LAKE WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, T. De Boer, H. A. Kramer, and J. Voerman.
Water Research, Vol 16, No 6, p 1047-1050, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Chemical oxygen demand, *Organic carbon, *Pollutant identification, Ultraviolet radiation, Tjeukemeer, *The Netherlands, *Humic acids, Lakes, Turbidity, Water analysis, Oxygen demand.

Ultraviolet absorbance at 250 nm (E250) was a suitable estimator of dissolved organic carbon in humic, eutrophic water from Tjeukemeer, the Netherlands. The correlation of E250 with COD of filtered water samples did not change from year to year during 1970-1980 (with the exception of 1970-72, during a period of sediment resuspension) and was independent of sampling stations. Absorbance at 365 nm showed linear correlations but was more variable. The variability of the water quality (from oligohaline, transparent, and eutrophic in summer to fresh, highly colored, and eutrophic in winter) did not interfere with the method. Although turbidity measurements at 436, 530, and 620 nm and COD data from unfiltered water samples were linearly correlation coefficients and slopes of the correlation varied irregularly. (Cassar-FRC)
W82-06773

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,
Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
S. A. Nichols.
Water Resources Bulletin, Vol 18, No 3, p 521-523, June, 1982. 3 Tab, 9 Ref.

Descriptors: *Biomass, *Sampling, Aquatic plants, Stratification, Stratified flow, Lakes, Lilly Lakes, *Wisconsin, *Pollutant identification.

The value of a stratified random system for improving the efficiency of biomass sampling is discussed along with factors which might be used to stratify samples. A case study is demonstrated at Lilly Lake, Wisconsin, where a statified random sampling reduced sampling effort by about 37%. During the summer of 1976 a sampling plan was devised to estimate macrophyte biomass of Lilly Lake. At that time the lake area was 36.6 hectares, with a maximum depth of 2.4 meters. The lake was dredged after 1976. The bottom was primarily muck, with sand and gravel predominating in the shallow water along the southeast shore. Ten strata were constructed. A preliminary survey was undertaken on August 10, 1976, to determine the biomass variability of the strata. Biomass variations within and between strata were analyzed using a one-way analysis of variance test. A significant difference in mean biomass was demonstrated. According to the data collected, about 308 samples would be needed to adequately sample the lake in a completely random fashion. In the case of Lilly Lake approximately three person days of effort would be saved for each time it was necessary to adequately sample the biomass of the lake using the stratified random sampling system proposed. This procedure can be used to design similar sampling strategies where information about species composition or growth curves for important macrophyte species is desired. (Baker-FRC)
W82-06779

SEPARATION OF AQUEOUS ORGANIC MIXTURES BY PERVAPORATION AND ANALYSIS BY MASS SPECTROMETRY OR A COU-

PLED GAS CHROMATOGRAPH-MASS SPECTROMETER,
Centre de Recherches Rhone-Poulenc Industries, Aubervilliers (France).
H. Eustache, and G. Histi.
Journal of Membrane Science, Vol 8, No 2, p 105-114, March, 1981. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Pervaporation, *Organic compounds, *Membrane processes, *Pollutant identification, Water analysis, Wastewater analysis, Industrial wastewater, Mass spectrometry, *Chlorinated hydrocarbons, *Aromatic compounds, Volatile compounds, Separation techniques, Gas chromatography.

A quick method for analysis of volatile organic compounds in dilute aqueous solution includes separation by pervaporation coupled with mass spectrometry or gas chromatography/mass spectrometry. The pervaporation process uses a membrane with the liquid mix on one side and a vacuum on the other. As the compounds pass through the membrane they are directly analyzed by mass spectrometry. Of the 4 membranes studied, TS-605, a cross-linked polydimethylsiloxane on a polyester support, has the highest enrichment factors for most compounds tested (benzene, styrene, chloroform, 1,2-dichloroethane, ethanol, acetone, acetic acid, n-butyl acetate, ethyl ether, pyridine, acetaldehyde, and vinyl chloride). Covitep, a low density polyethylene, is better than TS-605 for toluene, n-hexane, and cyclohexane. Polyethylene terephthalate and cross-linked polyvinyl alcohol membranes show little evidence of enrichment. Four examples are described: assay of trace levels of styrene in water, assay of trace levels of vinyl chloride in water, identification of oxygenated impurities of 1,2-dichloroethane, and analysis of industrial wastewater before treatment. (Cassar-FRC)
W82-06791

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, NV.
A. F. Maciorowski, L. W. Little, L. F. Raynor, R. C. Sims, and J. L. Sims.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 830-848, June, 1982. 325 Ref.

Descriptors: *Literature reviews, *Bioassays, *Reviews, Water quality, Fish, Aquatic life, Monitoring, Bioindicators, *Pollutant identification, Pollutants, Water pollution control.

Recent research conducted in the area of bioassays to describe, evaluate, and predict potential hazards related to water pollution is cited in this literature review. Biodegradation testing methodology of chemicals as well as their fate in aquatic environments formed the subject of a symposium. The development and applicability of US EPA water quality criteria were reviewed. Biological monitoring took on a variety of meanings. A tiered approach to effluent monitoring using both chemical and biological test protocols was prepared. Sentinel organisms to indicate contamination of natural waters by pollutant accumulation and uptake constituted another approach to biological monitoring. The radionuclides americium-241 and plutonium-237 were found to turn over differentially in the mussel Mytilus galloprovincalis, and were discribed as the sum of three exponential functions. Work was also carried on in the areas of design, interpretation, and strategy of toxicity test systems; in the use of bacteria to detect pollutant effects; in assays with algae and other plants; on the use of invetebrates to detect toxic substances; on fish and amphibians as bioassay test organisms; on comparative testing in microcosms; and in health effects assays. (Baker-FRC)
W82-06810

MODIFICATION OF THE HYDROGEN PEROXIDE METHOD OF DETERMINATION OF TOTAL PHOSPHORUS IN NATURAL WATERS,
Centro de Edafologia y Biologia Aplicada del Cuarto, Seville (Spain).
F. Cabrera, E. Diaz, C. G. Toca, and P. De Arambarri.
Water Research, Vol 16, No 6, p 1061-1064, June, 1982. 3 Tab, 8 Ref.

Descriptors: *Water analysis, *Phosphorus, Natural waters, Marshes, Rivers, Chemical analysis, Digestion, *Pollutant identification.

Possible explanations for apparently conflicting analyses in the determination of 'total dissolved and suspended phosphate' and 'filterable orthophosphate' are discussed. A modification to the hydrogen peroxide-sulfuric acid digestion method used for determining total dissolved and suspended phosphorus in natural waters is presented in order to avoid loss of phosphorus by adsorption on hydrous iron and aluminum oxides formed during neutralization prior to filtration. By adding an extra volume of sulfuric acid after neutralization so that such oxides are dissolved, thus permitting the adsorbed phosphorus to pass into solution, more reliability for the method is obtained. Water samples were studied from the Guadiamar river and Guadalquivir marshes. The results indeed confirm that the presence of iron and/or aluminum materials in these natural waters may cause a loss of phosphorus when it is determined by the hydrogen peroxide-sulfuric acid method. The loss of phosphorus is dependent upon the final acidity of the digestion liquor filtrate and is overcome if the acidity is high enough to dissolve the hydrous oxide precipitated by neutralization with sodium hydroxide. The evidence suggests that a period of 30 minutes after the addition of 0.5 ml of 5N sulfuric acid was sufficient time to dissolve the iron and aluminum precipitation before filtering. (BakerFRC)
W82-06828

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,
Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
For primary bibliographic entry see Field 5C.
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
P. S. Tabor, and R. A. Neihof.
Applied and Environmental Microbiology, Vol 43, No 6, p 1249-1255, June, 1982. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Microorganisms, *Microscopy, *Respiration, Bacteria, *Pollutant identification, Fluorescence, Estuarine environment, Microbiological studies.

Individual respiring microorganisms and the total microbial population were determined by a combination of two methods: detection of electron transport system activity and epifluorescence microscopy. 2-(p-iodophenyl-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) was reduced by the active cellular electron transport system to INT-formazan, visible as opaque intracellular deposits upon staining the microorganisms with acridin orange. Microorganisms were transferred from a filter to a gelatin film on a cover glass, then coated with additional gelatin to produce a transparent matrix. This method detected 2- to 10-fold more respiring microorganisms in a Chesapeake Bay water sample (56-61%) than were previously reported for marine or fresh water samples. Significant losses in microorganism counts were experienced when samples were prepared with immersion oil or Nuclepore filters. (Cassar-FRC)
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
P. A. Montagna.
Applied and Environmental Microbiology, Vol 43, No 6, p 1366-1372, June, 1982. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Bacteria, *Sampling, *Sediments, Microscopy, Mud, Sand, *Pollutant identification, Marine sediments, North Inlet, South Carolina, Statistical analysis.

The spatial and temporal distribution of marine bacteria in two types of sediments, muddy and sandy, were examined at a subtidal site at North Inlet, South Carolina. The experiment was designed to study the statistical aspects of sampling bacteria in the sediment, where bacteria are numerous and adhere to particles. The cell count, determined by acridine orange epifluorescence microscopy, fit a log-normal distribution. Bacterial numbers were 100 billion per g dry weight of mud and 1 billion per g dry weight of sand. Vvariations due to subsampling procedures were always statistically significant. The common practice of counting 20 fields from 1 filter preparation, adequate for bacterial counts in the water column, was not suitable for determining the bacterial population variance in marine sediments. It was recommended that replication of the subsampling level be performed. Data indicated that bacteria were more homogeneously distributed in sand than in mud. (Cassar-FRC)
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,
Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
E. M. Smith, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 43, No 6 p 1440-1450, June, 1982. 4 Fig, 8 Tab, 47 Ref.

Descriptors: *Wastewater analysis, *Microbiological studies, Rotaviruses, Water analysis, *Pollutant identification, Houston, *Texas, Pathogens, Diseases.

A method for concentrating rotaviruses from tap water, treated sewage, and raw sewage was developed using the simian rotavirus SA11. The method was based on adsorption to and elution from Filterite fiberglass epoxy filters. Optimal conditions for adsorption of the virus were 0.5 nM AlC13 at pH 3.5 and for elution, 0.05 M glycine-NaOH supplemented with 10% tryptose phosphate broth at pH 10. The SA11 was counted by plaque assay; the human rotavirus, by immunofluorescence. Rotavirus was detected in raw and treated dewage from two Houston, Texas, treatment plants. Several criteria confirmed that the rotavirus was a human strain: immunofluorescence, neutralization with convalescent sera from humans infected by a rotavirus, neutralization or immunofluorescence with preimmune or preillness sera, sensitivity to pH 11 and other inactivating agents, byoyant density of 1.36 g per cu m (comparable to that reported for complete, infectious rotavirus particles), and a double-shelled particle diameter of 67.1 nm. The electron micrograph of cell lysates inoculated with sewage isolate showed particles similar to rotavirus in morphology. (Cassar-FRC)
W82-06885

FLUOROMETRIC DETERMINATION OF DNA IN AQUATIC MICROORGANISMS BY USE OF HOECHST 33258,
Naval Research Lab., Washington, DC.
J. H. Paul, and B. Myers.
Applied and Environmental Microbiology, Vol 43, No 6, p 1393-1399, June, 1982. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Bacteria, *Deoxyribonucleic acid, *Fluorometry, *Pollutant identification, Microorganisms, Water analysis, Microbiological studies, Dyes, Hoechst 33258, *DNA.

Microbial DNA was detected at 0.05-10 microgram levels in bacterial cultures and natural water samples by a method based on the use of Hoechst 33258 dye, which increases in fluorescence in the presence of DNA. The simple process involved extraction of DNA and determination of DNA by fluorometry. A study of extraction methods showed that sonication after suspension in SSC (NaCl, trisodium citrate solution at pH 7.0) and sonication of cells on membrane filters released

100-104% of the DNA. Treatment of extracts with DNase I showed that 95-100% of the observed fluorescence was from DNA. DNA was correlated with bacterial cell numbers as determined by the acridine orange direct count. DNA in environmental samples ranged from 165 ng per ml in eutrophic Potamac River water to 27 ng per ml for coastal Atlantic Ocean water. (Cassar-FRC)
W82-06889

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
D. A. Brashear, and R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 6, p 1413-1418, June, 1982. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Viruses, *Sludge analysis, Wastewater analysis, Pollutant identification, *Elution, Centrifugation, Flocculation, Freon, waste treatment.

Five methods for recovering viruses from raw domestic wastewater sludge were compared. All methods included elution, concentration, and disinfection steps. Methods were: (1) freon elution, (2) water elution, (3) beef extract elution, (4) ASTM-1, aluminum chloride and beef extract, designed for primary and digested sludges, and (5) ASTM-2, beef extract and sonication, designed for anaerobically digested sludge. The most effective method was freon elution, followed by centrifugation and disinfection with ether. Concentration by centrifugation was more effective than by flocculation. Average relative virus recoveries, based on freon elution centrifugation results as 1.0, were: Method 2 with centrifugation, 0.72; Method 3 with centrifugation, 0.59; Method 4 unconcentrated, 0.57; and Method 5, 0.27. Efficiency of recovery was greatest in BGM cells, followed by RD and MA-104 cells. (Cassar-FRC)
W82-06890

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,
Veterans Administration Medical Center, Pittsburgh, PA.
For primary bibliographic entry see Field 5B.
W82-06891

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,
Michigan University, Ann Arbor. Great Lakes Research Division.
W. Y. B. Chang, and R. Rossmann.
Hydrobiologia, Vol 88, No 3 p 245-249, May, 1982. 3 Tab, 13 Ref.

Descriptors: *Chlorophyll, *Phytoplankton, *Sample preparation, Algae, *Sonification, *Grinding, Diatoms, Cyanophyta, Water analysis, *Lake Michigan.

The chlorophyll recovery efficiencies of control, ground, and sonificated samples of phytoplankton were compared with samples collected at a depth of 5.5 m in the intake forebay of the Donald C. Cook Nuclear Plant on Lake Michigan. The six treatments used were: (1) control, (2) 45 sec sonification in an ice bath, (3) 45 sec sonification in an ice bath with vigorous shaking, (4) 3 min sonification in an ice bath, (5) 3 min grinding, and (6) 3 min grinding in an ice bath. Chlorophyll b levels were very low; no significant differences in recovery efficiencies were discerned. However, significant increases in concentrations of chlorophylls a and c were found between control and ground samples but not between controls and sonificated samples. Increasing sonification time or using an ice bath during grinding did not improve pigment recovery efficiency. Results of the 1976 samples tested (containing centric diatoms and filamentous blue-green alga) showed that ground samples exhibited 22-40% more chlorophyll a and 62-87% more chlorophyll c than sonificated samples. However, the 1977 samples, except for one showed no significant differences. Grinding recovered more chlorophyll c than sonification when total phytoplankton numbers were high. Grinding is the preferred method for sample preparation, but in some cases it may not improve recovery compared to no grinding. These situations include phytoplankton populations under severe nutrient limitation or subjected to extensive herbivore predation or to disease. (Cassar-FRC)
W82-06902

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 5C.
W82-06907

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,
Freshwater Fisheries Lab.
For primary bibliographic entry see Field 5C.
W82-06909

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,
Environmental Protection Agency, Cincinnati, OH.
R. H. Bordner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 024-1037, June, 1982. 156 Ref.

Descriptors: *Literature reviews, *Microbiological studies, *Water analysis, *Wastewater analysis, *Bacterial analysis, Microorganisms, Quality control, *Pollutant identification, *Reviews, Pathogens, Coliforms, Salmonella, Sampling, Monitoring, Bioassay, Toxicity, Mutagens, Bacteria, Vibrio, Water quality, Aeromonas, Klebsiella.

A review of recent literature on microbiological methods in water and wastewater analysis includes the 15th edition of 'Standard Methods for the Examination of Water and Wastewater.' About 75 papers are noted which concern new isolation and enumeration procedures. Many of these are comparisons of different procedures such as membrane filter, most probable number and its variations, plating, and direct count using coliforms and other fecal bacteria. Selective procedures are given for microorganisms such as Legionella pneumophila, Yersinia, Campylobacter, Vibrio, Aeromonas, Klebsiella, Salmonella, and Listeria. There is great interest in commercially available diagnostic kits, multitest systems, and automated computerized methods for bacterial identification, as evidenced by about 25 publications on testing and comparison of these systems. Sampling considerations include special problems of collecting specimens from boats, under ice cover, in stratified waters, from aquifers, in streams, wastewaters, boiler water, industrial effluents, sediments, at bathing beaches, and in deep waters. New approaches to rapid methods for bacterial enumeration are discussed. Examples are radiometric, serological, electrochemical, enzyme, chromatographic, and chemiluminescent methods. Bacteria are used in bioassays for toxic or mutagenic substances, for example, Nitrobacter for assessing wastewater toxicity, effects of dyes on bacterial action, and improvements and development of the Ames Salmonella test. Quality control schemes are described, using control cultures and statistical methods. Several possible sources of error are mentioned, such as stacking plates, and nonuniform cooling rates. Health hazards to laboratory workers include infections from pathogens used in the Ames test and typhoid fever from the very infectious Salmonella typhi, sometimes used in testing disinfectants. (Cassar-FRC)
W82-06919

ORGANICS,
Washington Univ., Seattle. School of Public Health and Community Medicine, Department of Environmental Health.
F. B. DeWalle, C. Lo, J. Sung, D. Kalman, and E. S. K. Chian.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, 555-576, June, 1982. 8 Tab, 242 Ref.

Descriptors: *Literature reviews, *Organic compounds, *Water anaylsis, *Wastewater analysis, *Fate of pollutants, *Pollutant identification, *Reviews, Organic matter, Biological oxygen demand, Organic carbon, Hydrocarbons, Pesticides, Insecticides, Herbicides, Sediments, Quantitative analysis, Detergents, Surfactants, Chlorinated hydrocarbons, Sludge, Polychlorinated biphenyls, Aquatic animals, Runoff, Drinking water, Groundwater, Surface water, Industrial wastewater, Degradation, Aromatic compounds.

Recent publications concerning analysis of organics in water are reviewed. An overview of nonspecific methods (total organic carbon, COD, and BOD) is followed by group methods and compound specific methods. The group methods include techniques for determination of total amounts of acids, aldehydes and hydrocarbons. Compound specific methods quantitate individual compounds. The references are grouped into 8 tables with the following headings: methods of detection and identification of detergents and related compounds; methods of identification and quantification of aliphatic and aromatic hydrocarbons; presence, degradation, and attenuation of aliphatic and aromatic hydrocarbons; methods for identification and quantification of pesticides, chlorinated hydrocarbons, and related compounds; presence, degradation, and attenuation of pesticides, chlorinated hydrocarbons, and related compounds; methods for identification and quantification of naturally occurring organics; methods for identification of organics present in surface and groundwater, drinking water, wastewater, and other media; and degradation and attenuation of organics in surface and groundwater and wastewater. These tables list the sample type (for example, sediment, wastewater, soil runoff), the compound(s) being determined, methods, and significant results. (Cassar-FRC)
W82-06922

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,
Alaska Univ., Fairbanks, Inst. of Marine Science.
W. S. Reeburgh, and R. E. Erickson.
Limnology and Oceanography, Vol 27, No 3, p 556-559, May, 1982. 3 Fig, 7 Ref.

Descriptors: *Pollutant identification, *Sampling, *Sediments, *Chemical analysis, Chemical composition, Bays, Sulfides, Measuring instruments, Interstitial waters.

An approach is presented to obtaining rapid, continuous profiles of chemical components of sediments which involves in situ equilibration of a thin band of polyacrylamide gel cast in a Lucite support or dipstick. The support-gel combination is inserted into sediments or cores and equilibrates rapidly with adjacent interstitial waters. The gels are transparent and relatively inert chemically for short exposures. They have high water content, are nonionic and are durable enough to resist tearing in sandy sediments. The gels can be dosed with specific color-forming reagents which react with components in the sediments and provide a visual semiquantitative indication of depth distributions. They can also be used as equilibration samplers and sectioned for extraction and analysis after retrieval. Results of sediment analysis using these dipstick samplers are presented for sulfide containing sediments in Skan Bay. This bay is a silled basin on the northwest side of Unalaska Island (Aleutian Islands) with anoxic sediments. Dipstick samplers, when dosed with appropriate reagents, give rapid, continuous, semiquantitative measurements of sulfide in anoxic marine sediments. (Baker-FRC)
W82-06931

CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),
Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, Y. Yokoyama, and S. Suzuki.
Japanese Journal of Limnology, Vol 43, No 1, p 5-10, January, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: Rivers, *Organic compounds, Aromatic hydrocarbons, Aliphatic hydrocarbons, *Sediments, Ara River, Tama River, *Japan, Organochlorine compounds, Phthalate esters, Chemical analysis, Water analysis, Water pollution, Industrial wastes.

An approach for characterizing organic pollutants in sediments of an urban river is presented. The organic matter content of sediments in the downstream areas of the Tama and the Ara Rivers was 2-5 times as great as that of sediment upstream. The sedimentary organic matter was extracted successively with water, n-hexane, ethyl acetate, methanol, and 1 N NaOH. The amounts of organic water extracted with n-hexane or ethyl acetate from the downstream sediment in the Tama River were remarkably higher than those from stream sediment. In the downstream areas of the Ara River the amounts of n-hexane, water and 1 N NaOH extracts were higher than those in the upstream ones. The n-hexane extract obtained from the sediment downstream in the Tama River was further separated into three fractions by silica gel and silica gel/alumina column chromatography. These sub-fractions were characterized by IR, NMR, GC, TLC, and elemental analyses. The analyses indicated that the organic compounds present in larger amounts downstream were aliphatic and aromatic hydrocarbons, organochloine compounds and phthalate ester. (Baker-FRC)
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,
Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
L. W. Lion, R. W. Harvey, and J. O. Leckie.
Marine Chemistry, Vol 11, No 3, p 235-244, 1982. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Estuarine environment, *Trace metals, Copper, Cadmium, Lead, Estuaries, *Salt marshes, Microorganisms, Microenvironment, San Francisco Bay, Bays, Particulate matter, *Organic carbon.

The relative importance of metal complexation with dissolved surface-active organic ligands, metal adsorption to particle surfaces, and bacterial uptake of metals were evaluated as processes which control the partitioning of cadmium, copper and lead in the surface microlayer of an estuarine salt marsh. The importance of each mechanism was evaluated by comparing observed trace metal enrichment in the dissolved and particulate forms with the enrichment of dissolved organic carbon (DOC), particles and bacteria. Salt marsh field samples were obtained at the confluence of a salt marsh drainage channel with the South San Francisco Bay estuary. Little or no partioning of DOC was noted in either tidal cycle, while particle numbers and bacteria were found to be enriched at the surface microlayer in several instances. The lack of DOC partitioning suggests that little or no partitioning of dissolved Cd, Cu or Pb would be expected. Study revealed that particulate Cd, Cu, and Pb were partitioned during events in which particle enrichment was observed, and with the exception of dissolved Pb in the first sample of each tidal cycle, minimal partitioning of dissolved metals was noted in both tidal studies. The observed levels of partitioning of dissolved, particulate and total Cd, Cu and Pb and the correlation between the partitioning of particulate metals and particle numbers strongly suggest that microlayer enrichment of trace metals is controlled by the behavior of particles, for example, bacteria, organic detrital materials and inorganic components such as clay minerals. The observed distributions of Cd, Cu and Pb between the dissolved and particulate phase were consistent with their calculated chemical speciation in computer-simulated surface microlayer and bulk seawater. (Baker-FRC)
W82-06975

INORGANICS,
Pope Scientific Inc., Menomonee Falls, WI.
D. S. Polcyn.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 520-540, June, 1982. 15 Tab, 379 Ref.

Descriptors: *Literature reviews, *Inorganic compounds, *Water analysis, *Spectroscopy, *Reviews, *Pollutant identification, Computers, Quality control, Sample preservation, Trace metals, Chemical analysis, Chelation, Speciation, Metals, Heavy metals, Chromatography, Hydrogen ion concentration, Electrodes, Conductance, Atomic absorption spectroscopy, Emission spectroscopy, X-ray spectroscopy, Flow injection analysis, Voltammetry, Reagents, Potentiometers, Ion-selective electrodes.

A review of the recent literature on analysis of inorganics in water includes new books and reviews, the use of computers and microprocessors in analysis, data analysis and quality control, interactions of samples with containers, preparation of high purity reagents, corrections for air buoyancy in weighing granular or powdered materials, sample concentration, detection and distribution of trace metals, complexation, speciation, and interlaboratory studies. A table lists various constituents found in water (metals, chlorine, silicon, and other selected elements) and references concerning studies of their speciation. The remainder of the literature references on inorganic analysis is organized into 14 tables: chromatographic methods (gas, ion, and liquid); pH (analysis and methods); selective ion electrodes (reviews, theory, and application); voltammetry (reviews, theory, and applications); voltammetry and stripping analysis (anodic and potentiometric); conductance; atomic absorption spectroscopy (reviews, theory, and application); atomic absorption spectroscopy and hydride formation; flame emission spectroscopy; inductively coupled plasma emission spectroscopy; X-ray spectroscopy (emission and fluorescence); miscellaneous instrumental methods; flow injection analysis; and analysis for specific constituents. The constituents are arranged alphabetically by name and include elements, cyanide, and thiocyanate. (Cassar-FRC)
W82-06999

5B. Sources Of Pollution

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
L. N. Mielke, and J. R. C. Leavitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243452, Price codes: A02 in paper copy, A01 in microfiche. Report, June 1981. 17 p, 7 Tab, 9 Ref. OWRT A-062-NEB(1). 14-34-0001-0129.

Descriptors: *Herbicides, *Agricultural runoff, *Irrigation, *Surface runoff, *Pesticide toxicity, Pesticide drift, Sediment transport, Sediments, Sprinkling, Sprinkler irrigation, Spray irrigation, Water pollution, Water pollution sources, Irrigation practices, Irrigation effects, Environmental effects, Pollutants, Pollutant load, Water pollution effects.

Herbicide runoff losses for atrazine and alachlor were studied under three types of center pivot irrigation with conventional and minimum tillage: conventional high-pressure impact sprinkling; low-pressure impact sprinkling; and low-pressure spraying. Tillage practices that emphasize the use of the disk and minimum tillage enhance the potential for herbicide runoff. Nonetheless, herbicide losses can be minimized under topographic and soil conditions conducive to runoff by selecting the proper irrigation system. Herbicide water solubility affects the runoff pattern: water-soluble herbicides are susceptible to initial runoff events, with more of loss associated with water solubility. However, the amount of herbicide carried on the sediment is minimal, even with a relatively insoluble herbicide (e.g., atrazine). Accumulative herbicide runoff loss after three consecutive events did not exceed 0.1% of the amount applied, even under conditions favoring runoff. Furthermore, the amount of herbicide in runoff material, coupled to the degree of dilution that normally occurs between the site of runoff and herbicide-sensitive crops, is sufficient to make phytotoxic events due to herbicide runoff rare. (Zielinski-MAXIMA)
W82-05921

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,
Georgia Univ., Athens. Inst. of Ecology.
E. R. Blood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243569, Price codes: A10 in paper copy, A01 in microfiche. Report ERC 06-81, September, 1981. 194 p, 30 Fig, 26 Tab, 96 Ref. OWRT B-138-GA(1).

Descriptors: *Surface runoff, *Stream upflow, *Water analysis, *Hydrologic models, *Swamps, Surface water, Streams, Streamflow, Stream profiles, Stream discharge, Bogs, Marshes, Water quality, *Environmental effects, Hydrology, Model studies, Chemical analysis, *Okefenokee Swamp, Georgia, Florida.

Surface water runoff to the swamp from upland streams is not uniformly distributed. Low topographic relief, highly leached sandy soils, and land use practices contribute to low flow, low sediment yields and low nutrient characteristics of the upland surface water. Investigation of the swamp system level biogeochemistry and hydrology, and several factors influencing them (geomorphology, environmental variables, anthropogenic perturbations) provided some insight of swamp ecosystem homeostasis. Upland surface water low salinity and low sediment yields are a function of the predominance of silvicultural practices on the uplands. Low agricultural use and little urbanization minimize anthropogenic inputs of sediments and nutrients to the streams. The model developed provides new insights into swamp hydrology and some weaknesses of using a static model to reflect a hydrologically dynamic ecosystem. System level biogeochemistry was assessed through the biogeochemistry of the major hydrologic components. The swamp surface water is similar to other blackwater systems, having low pH and ionic strength, high organic carbon which influences water quality and chemistry, and a predominance of organic or reduced nutrient forms. Seasonal dynamics, precipitation, upland stream channelization, and cation/anion distributions are discussed. (Zielinski-MAXIMA)
W82-05933

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,
Kansas Water Resources Research Inst., Manhattan.
E. E. Angino, and D. A. Kopsick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243593, Price codes: A06 in paper cpy, A01 in microfiche. Report and Supplement to Contribution No 211, June, 1981. 110 p, 24 Fig, 16 Tab, 9 Plates, 62 Ref, 4 Append. OWRT A-087-KAN(2). 14-34-0001-8018.

Descriptors: Fly Ash, Bottom Ash, *Leachates, Water Quality, *Coal mining, *Mine wastes, *Gob, Groundwater pollution, *Geochemistry, Inorganic wastes, *Missouri.

During the coal, large amounts of inorganic material (gob) are removed with thee coal. After cleaning of the coal, this waste is deposited adjacent to the mined area. One of these gob piles, located in Barton County, Missouri, is evaluated as to chemi-

cal composition of the waste, leaching characteristics of the waste and mineralogy of secondary minerals deposited at the pile. This waste material is enriched in Pb, Zn, Cd and Cu, relative to the abundances of these elements in average shales. Leachate from this material shows elevated concentrations of Zn and Cd. After twenty-five years of weathering, this gob is still producing leachate with high concentrations of Cd, Mn, Cu, Zn and Fe. Various hydrous states of ferrous sulfate, ranging from szomolnokite, FeS04H2O, to melanterite, FeS04.7H2O were identified from minerals collected at the pile. Analysis of the monohydrate form showed enrichment in Fe, Mg, Zn, Cd, Cu and Mn, relative to the whole gob sample and leachate sample. Two types of coal combustion wastes, fly ash and bottom ash, from five coal producing provinces of the United States are discussed in relation to Ca, Mg, Na, K, Mn, Fe, Cu, Zn and Pb concentrations in the whole sample and in the leachate generated from these ashes. Fly ash from northeast Missouri coal yields a leachate enriched in Pb, Zn, Cu, Fe, Mn and Cd, relative to other leachates, which is indicative of mineralization from nearby lead-zinc deposits. Leachates from two Wyoming fly ashes and bottom ashes exhibit low trace metal concentrations and high Ca, Mg, Na and K concentrations. Intermediate between these two samples are the coompositions of leachates generated from the ashes of eastern Kentucky and southern Illinois coal. An evaluation of geology, hydrogeology, soil chemistry and groundwater chemistry at an ash disposal site of a coal-fired power plant showed elevated concentrations of Ca, Mg and Na plus K in the leachate of the coal ash relative to native groundwater. Only trace amounts of Mn, Fe, Cu, Zn are present in the ash leachate and no degradation of the local groundwater quality is predicted for this site. (See also W80-04604)
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
J. W. Talbot.
Ocean Science and Engineering, Vol 6, No 3, p 301-333, 1981. 13 Fig, 1 Tab, 23 Ref.

Descriptors: Estuaries, Water currents, *Thames estuary, *England, Mathematical models, *Model studies, *Wastewater disposal, Sludge, Sludge disposal, Ocean dumping, *Path of pollutants, Water circulation.

The problem of the dispersal of the products of sewage sludge dumping in the Thames Estuary was examined using a mathematical model in conjunction with conventional field measurements. The conventional methods employed included moored recording current meters, sea-bed drifters and a radioactive-tracer release. Some 5 million tons of digested sludge are dumped each year in the Barrow Deep channel of the outer estuary. The Thames Estuary is an area of moderate tidal velocities, in some parts 2 knots being exceeded on spring tides. It is also an area of shallow water with a complicated bottom topography, including a system of sandbanks, many of which dray out at low water and which alternate with channels whose maximum depth is about 20 meters. It was also necessary to consider the effects of the residual component, as the estuary lies between a southerly flow down the English east coast and a northeasterly flow through the Dover Strait. Dispersal is thus likely to be complex. Current meter records indicated that water takes between 2 and 2.5 hours to move from the position of a patch at 1450 hr to the position of the center of a patch found on the sea bed. The labeled sludge began to fall in the water column as high water approached, but the main deposition on the bed occurred close under the East Barrow sandbank between 2 and 2.5 hours after high water. Two major conclusions of the study were that the movement was in general to the south. However, there was some strong evidence for a northerly drift close to the Essex coast, and drifters released in the Wallet probably moved initially to the northeast before joining the general southerly drift further offshore. No evidence was found to indicate a general near-bed transport into the Thames. (Baker-FRC)
W82-05946

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-05964

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 13, No 4, p 135-138, April, 1982. 2 Fig, 2 Tab, 13 Ref.

Descriptors: Estuaries, *Radioactive wastes, *Ravenglass Estuary, *Cesium-137, Sediments, Pollutant identification, Nuclear energy, Fuel, *Path of pollutants, *England.

Ravenglass Estuary is located about 10 km south of the Sellafield nuclear fuel reprocessing facility. A survey is reported of the important gamma emitting fission products found in the surface sediments of the estuary in May of 1978. The influence of the silt sized content of the surface sediments on the geographical distribution of fission products is discussed. The results are compared with recent annual mean results published by the Ministry of Agriculture, Fisheries and Fodd (MAFF) for their monitoring of the Newbiggin site. Sediment samples were collected by carefully removing the uppermost 0.5 cm over a 1 square meter area at each location. A detailed survey of gamma emitting fission products in the surface sediments of the estuary shows that considerable variations occur, and that for cesium-137 and to a lesser extent for other radionuclides, the proportion of silt present is an important control of their distributions. The annual mean surface sediment activities reported by MAFF for a single site sampled at monthly intervals are significantly lower than those found at the majority of sites in the overall estuary. (Baker-FRC)
W82-05984

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
T. C. Lederman, and G-Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 380-387, March, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Algae, *Bioaccumulation, *Hexachlorobiphenyl, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, Accumulation, Adsorption, Phytoplankton, Insecticides, Biomass, Desorption, Fate of pollutants, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

Bioconcentration factors for 2,4,5,2', 4', 5'-hexachlorobiphenyl (HCB)were in the range off 100,000 to 1 million for Great Lakes algae Fragilaria crotonensis, Ankistrodesmus falcatus, and Microcystis sp. Bioconcentration factors were higher in A. falcatus than in the other 2 species, twice as high in dead cells as compared to live cells, lower in greater biomas es per unit volume of culture, and an order of magnitude lower for frustules than live and dead cells. Surface absorption was not an important fator in HCB bioaccumulation. F. Crotonensis cells with a mucilagenous layer had bioconcentration factors twice as high as cells with the layer removed. The concentration of HCB within the range used (up to 630 ng per liter) did not change the order of magnitude of the bioconcentration factor. Desorption rates of HCB were much lower than adsorption rates, with A. falcatus showing the greatest desorption and Microcystis the least. (Cassar-FRC)
W82-05991

VARIABILITY OF STREAM WATER QUALITY IN SOME LAND MANAGEMENT SYSTEMS IN THE SOUTHERN KAKIOKA BASIN, JAPAN,
Tokyo Univ. (Japan). Dept. of Botany.
T. Hirose, and N. Kuramoto.
Agro-Ecosystems, Vol 7, No 1, p 47-61, 1981. 4 Fig, 7 Tab, 23 Ref.

Descriptors: *Water quality, *Land use, *Forest watersheds, *Agricultural watersheds, Kakioka Basin, *Japan, Land management, Cropland, Nitrates, Nitrites, Ammonium, Phosphates, Potassium, Sodium, Calcium, Magnesium, Fertilizers, Livestock, Principal component analysis, Nutrients, Fate of pollutants, Seasonal variation.

The effects of land use on stream water quality and the diurnal and seasonal patterns of water quality were investigated at four sites in the predominantly rural Kakioka Basin, Japan. Concentrations of eight inorganic ions were determined (nitrate, nitrite, ammonium, phosphate, potassium, sodium, calcium, and magnesium). Site 2 and 4 were forest-covered. Sites 9 and 11 were cropland (paddy fields and upland fields) and livestock raising regions, but Site 11 was more heavily populated and had more livestock and fertilizer use than Site 9. Concentrations of all ions except phosphate increased with increasing land cultivation and human settlement. Principal component analysis determined that monthly veriations in ion concentrations were highly significant for all ions. Diurnal variations were significant for ammonium, Ca, and MG at Site 4; Mg at Site 9; and nitrite, ammonium, phosphate, K and Na at Site 11. At Sites 2 and 4 diurnal variations in stream water quality were small compared to monthly variations and to diurnal variations in streams under human influence. At Sites 9 and 11 diurnal variations were quite large, sometimes exceeding monthly variations. (Cassar-FRC)
W82-06020

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06033

THE ROLE OF SUSPENDED SOLIDS IN THE ESTUARINE GEOCHEMISTRY OF MERCURY,
Lancaster Univ. (England). Dept. of Environmental Sciences.
J. E. Rae, and S. R. Aston.
Water Research, Vol 16, No 5, p 649-654, May, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Suspended solids, *Mercury, *Estuary, Fate of pollutants, Adsorption, Wyre Estuary, England, Tides, Industrial wastes, Organic carbon, Mixing, Particle size, Sediments.

The mercury budget in surface waters of the Wyre Estuary, England, was studied at eight stations during a tidal cycle. This system is contaminated with industrial wastes, including chlor-alkali plant effluents. Mercury was strongly associated with suspended solids; the soluble fraction was never more than a few percent of total Hg present. At high chlorinity periods Hg concentrations in suspended solids decreased significantly and were correlated with increases in particle grain size (decreased surface area and decreased organic carbon content). Hg concentrations in suspended solids were linearly correlated with percentage organic carbon. Laboratory leaching experiments proved that Hg was not easily desorbed from particulate matter but was associated with the organic carbon fraction of the sediments. (Cassar-FRC)
W82-06035

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. Gibs, R. J. Schoenberger, and I. H. Suffet.
Water Research, Vol 16, No 5, p 699-705, May, 1982. 8 Fig, 4 Tab, 16 Ref.

Descriptors: *Buffer capacity, *Landfills, *Leachates, Carbonates, Model studies, Sanitary landfills, Organic acids, Acids, Degradation, Hydrogen ion concentration, Anaerobic conditions, Fate of pollutants.

A model of the buffer capacity of sanitary landfill leachate, based on the products of anaerobic decomposition, assumes that all organic acids are acetic acid. This simplification reduces the number and complexity of required chemical analyses and the calculations. The model was tested on two samples (winter and summer) of Bucks County, Pennsylvania, Landfill. The model predicted maximum buffer capacity pH within 0.35 of the actual value, but underpredicted the magnitude by 8-16%. It was accurate over a pH range of 6 to 10 for the winter sample and 3 to 10 for the summer sample. Carbonate contributed a minimum of 67% to the maximum buffer capacity. (Cassar-FRC)
W82-06038

ESTIMATION OF PRE- AND POST-DEVELOPMENT NONPOINT WATER QUALITY LOADINGS,
General Development Corporation, Miami, Florida, Environmental Planning and Programs Department.
A. N. Shahane.
Water Resources Bulletin, Vol 18, No 2, p 231-237, April, 1982. 2 Fig, 10 Tab, 16 Ref.

Descriptors: *Pollution load, *Land use, *Community development, *Nonpoint pollution sources, Water quality, Water pollution sources, Fate of pollutants, Runoff, Florida, Urban development, Nitrogen, Phosphorus, Suspended solids, Biological oxygen demand.

Three approaches were used to estimate pre- and post-development water quality loadings from two proposed Florida residential communities. Results from the second approach most closely resembled the results of the time-consuming third approach, a conventional hydrologic budget model combined with pollutant concentrations. The second approach involved summing existing annual data for recorded storms to produce pounds per acre per year loadings for suspended solids, total nitrogen, total phosphorus, and BOD5, determining the land use types for each phase of community development, and estimating pre- and post-development water quality loadings in terms of areal coverages of different land uses at various phases of development. Land use types included highways, flatwood/range, woodland, swamp, pasture, improved pasture, cultivated, residential multifamily, and commercial. (Cassar-FRC)
W82-06043

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,
Liverpool Univ. (England). Dept. of Oceanography.
D. Airey, and P. D. Jones.
Water Research, Vol 16, No 5, p 565-577, May, 1982. 5 Fig, 2 Tab, 50 Ref.

Descriptors: *Mercury, *Particulate matter, *Industrial wastes, *Path of pollutants, Fate of pollutants, Mersey Estuary, Dredging, Liverpool Bay, Pollution load, Rivers, Estuaries, Sediments.

Mercury levels were measured in water and suspended matter at 53 stations in the Mersey River system, quarterly from August 1973 to June 1974. A graph depicts the Hg load on particulate matter (micrograms per g), suspended Hg (micrograms per liter), and dissolved Hg (ng per liter). Highest mean Hg levels were found in the River Water (270 ng per liter dissolved Hg, 1.92 micrograms per liter particulate Hg, and > 80 micrograms per g Hg load) and in the Manchester Ship Canal (249 ng per liter, 1.2 micrograms per liter, and 24.3 micrograms per g, respectively). Most Hg was associated with particulates, more than 80% in a heavily polluted section where fresh water and seawater met. The load of Hg on particulates was low in August. Dissolved Hg concentrations and Hg load on particulate matter were always greater in freshwater than in tidal waters except during a flood. Low dissolved Hg levels were found in fresh water in August and in seawater in November; high levels were found in fresh water in June. Suspended Hg concentrations were higher in tidal areas than at fresh water stations. The estimated mean annual weight of Hg entering Liverpool Bay during the study period was 1.55 tons transported by water flow and 17 tons by dredging the channel and dumping spoils in the Bay. (Cassar-FRC)
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
M. E. Woolston, W. G. Breck, and G. W. VanLoon.
Water Research, Vol 16, No 5, p 687-691, May 1982. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Metals, *Bioindicators, *Algae, Fate of pollutants, Copper, Cadmium, Zinc, Manganese, Trace levels, Heavy metals, Ascophyllum nodosum, Seaweeds, Indicators, Accumulation, Bioaccumulation, Estuaries, St. Croix Estuary, Passamaquoddy Bay.

Concentrations of Cu, Cd, Mn, and Zn were determined in samples of the brown seaweed, Ascophyllum nodosum, collected in the St. Croix Estuary and Passamaquoddy Bay, between Maine and New Brunswick. There were greater statistical differences in concentrations of Mn, Cd, and Zn (but not Cu) between sites than between samples. Metal concentrations at different sites indicated trends, areas of uniformity, and local pollution sources. However, within any element there was no constancy of concentration factors (ratio of concentration of a particular element in the plant to that of the element in the water). (Cassar-FRC)
W82-06050

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,
Caulfield Inst. of Tech., Caulfield (Australia), Water Studies Centre.
B. T. Hart, S. H. R. Davies, and P. A. Thomas.
Water Research, Vol 16, No 5, p 605-612, May, 1982. 6 Fig, 2 Tab, 18 Ref.

Descriptors: Metals, *Sediment transport, *Pollution load, *Fate of pollutants, Heavy metals, Magela Creek, Australia, *Iron, *Manganese, *Zinc, *Copper, *Cadmium, Suspended solids, Conductivity, Denudation, Tropical regions, Weathering, Baseline studies.

Water quality in Magela Creek, Australia, was determined during five major floods during the 1978-79 wet season. This highly weathered undisturbed watershed contains uranium deposits recently approved for mining. Conductivity was low, 10-21 micros per cm. Suspended solids were 5-46 mg per liter, highest during the early stages of a flood event. It was calculated that in an average year 5300 tons of sediment were transported past the sampling point, representing a very low annual denudation rate. Trace metals loads were very low. Mean metals concentrations (micrograms per liter) were: Fe, 281; Mn, 7.8; Zn, 2.8; Cu, 0.41; and Cd, 0.04. Trace metals were also very low. Total amounts (in kg per sq km) transported during the wet season were: Fe, 117; Mn, 3.6; Zn, 1.3; Cu, 0.2; and Cd, 0.02. (Cassar-FRC)
W82-06054

EFFECTS OF DISSOLVED ORGANIC MATTER ON ADSORPTION OF HYDROPHOBIC ORGANIC COMPOUNDS BY RIVER- AND SEWAGE-BORNE PARTICLES,
Wisconsin Univ.-Madison. Water Chemistry Program.
J. P. Hassett, and M. A. Anderson.
Water Research, Vol 16, No 5, p 681-686, May, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Adsoprtion, *Particulate matter, *Organic compounds, *Cholesterol, Polychlorinated biphenyls, Suspended solids, *Fate of pollutants, Dissolved organic carbon, Organic carbon, Organic matter, Wastewater.

Adsorption of labeled cholesterol and 2,2',5,5'-tetrachlorobiphenyl by suspended solids from river water and treated sewage was studied in distilled water, sewage and river water and was compared to adsorption in solutions of organic matter concentrated by ultrafiltration. Sewage particulate matter was more effective in adsorption than river particulates. Dissolved organic matter reduced sorption of the two hydrophobic compounds by the particulate matter. Possible reasons for this interference are formation of complexes between the study compounds and the dissolved organic matter or competitive adsorption. Partition coefficients and standard free energies of adsorption are listed. (Cassar-FRC)
W82-06056

STORM RELATED DILUTION OF CONDUCTANCE IN THREE HYDROLOGICALLY DIFFERENT WATER BODIES,
State Univ. of New York at Syracuse, Coll. of Environmental Science and Forestry.
V. A. Ferro.
Water Resources Bulletin, Vol 18, No 2, p 311-316, April, 1982. 2 Fig, 13 Ref.

Descriptors: *Conductance, *Storm water, *Urban runoff, Fate of pollutants, Water quality, Ponds, Canals, Streams, Syracuse, New York, Butternut Creek, Runoff, Overland flow.

Electrial conductance was monitored in three water bodies on the fringe of metropolitan Syracuse, New York, in the summer of 1980 to determine the effect of precipitation on water quality. Results of measurements in a groundwater pond, Butternut Creek, and a canal showed that water quality was a function of hydrologic, precipitation, and watershed characteristics. In the groundwater pond means dry weather conductance was 1250 micromhos per cm. Precipitation and overland flow produced dilutions of 50-150 micromhos per cm in the littoral zone. A seasonal peak of 1400 micromhos per cm was attained in late August during a period of evaporative losses and low rainfall. In the creek the mean dry weather conductance was 740 micromhos per cm. Dilution, which decreased this value from 50 to 200 micromhos per cm, was governed by the orientation of the summer storm track (from the west) to the creek orientation (northerly). Extreme fluctuations in conductance (50-750 micromhos per cm) were measured in the Butternut Feeder Canal (mean base flow conductance 1175 micromhos per cm). These were a result of differences in land use. The steep urbanized areas contributed high amounts of dissolved solids to the canal. (Cassar-FRC)
W82-06067

SEDIMENT-WATER INTERACTIONS OF CU, ZN, AND PB DISCHARGED FROM A DOMESTIC WASTE WATER SOURCE INTO A BAY OF LOUGH NEAGH, NORTHERN IRELAND,
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey.
Environmental Pollution, Series B, Vol 3, No 3, p 199-214, 1982. 3 Fig, 8 Tab, 61 Ref.

Descriptors: *Sediment-water interfaces, Metals, *Zinc, *Copper, *Lead, Phosphorus, Sediments, Wastewater disposal, Path of pollutants, Trace metals, Municipal wastewater, *Ireland(Northern).

This study describes the influence of a mainly domestic wastewater discharge on the trace metal

regimes of Kinnego, Closet and Derryadd Bays, Southwest Lough Neagh, Northern Ireland, by means of their sediments. Lough Neagh is a shallow eutrophic lake which has developed to its present state through progressive cultural eutrophication. Two sewage disposal works discharge into the area, dumping sewage from primarily domestic sources. Surficial and pre-contamination concentrations of nickel, copper, zinc, lead, and phosphorus were measured at fourteen sites in the bays. Copper, zinc, lead, and phosphorus contamination was found in Kinnego Bay. The contamination increased towards the trace metal source, and copper was incorporated more rapidly into the sediment than the other metals. There was no contamination in the other bays. The current chemical models of trace metal behavior in aquatic systems were examined, and the selective incorporation of copper into the sediment was in agreement with model predictions. It was concluded that chemisorption to the sediment is the main sediment-water interaction of copper, zinc, and lead discharged in the waste water. (Baker-FRC)
W82-06080

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-06081

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2E.
W82-06093

WATER QUALITY AND HYDROLOGY IN A COASTAL REGION OF THE NETHERLANDS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
E. Van Rees Vellinga, C. G. Toussaint, and K. E. Wit.
Journal of Hydrology, Vol 50, No 1/3, p 105-127, March, 1981. 15 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality, *Saline water intrusion, *Surface water, *Netherlands, Agriculture, Fertilizers, Groundwater, Wastewater, Water pollution sources, *Rhine River, Hydrology, Aquifers, Geology, Geohydrology, Seepage, Chlorides, Polders, Path of pollutants, Cooling water, Phosphates, Nitrogen compounds, Infiltration, Transmissivity.

This paper summarizes the results of a 1976 multidisciplinary investigation on the geology, hydrology, and quality of surface water and groundwater in a 2000 sq km area of central-west Netherlands, where water quality has been deteriorating. The main problems are the pollution of the Rhine River water, used for water level control and flushing of polders; saline intrusion caused by harbor enlargement and deepening and by lowered polder levels; increases in demand for water in domestic and insturial uses, glasshouse horticulture, and agriculture; and increases in quantities of wastewater. The main source of salt contamination is seepage of saline groundwater; human activities are of minor importance. The geology of the region is described in detail. There are generally two aquifers, separated in some places by dividing layers and in other places forming a single thick aquifer. Transmissivities and flow intensity computations indicate 3 kinds of areas: seepage zones, infiltration zones, and zones with little seepage or infiltration. In the seepage zones surfce water quality reflects that of the groundwater. Infiltration zones require addition of Rhine River water during dry periods. The zones with little water movement are sensitive to digging, subsoiling, and channel improvement, all of which can change seepage rates. Groundwater in the area is generally hard and high in Fe, Mn, N, and phosphates. Chloride present in the water bearing strata of the region is about 430,000 metric tons; total net quantity welling up in the region, 150 metric tons per year. A table lists the sources and amounts of chloride inputs into surface waters. The gravest concern is the quality of the Rhine River water, which directly affects surface water quality in this area. Although seepage from natural sources cannot be changed to a great degree, water management has reduced the contributions of pollutants from cooling waters (via a direct pipeline to the North Sea), domestic wastewater, gas wells, and road defrosting. Fertilizer use is not expected to decrease. (Cassar-FRC)
W82-06103

THE OILSPILL RISK ANALYSIS MODEL OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
R. A. Smith, J. R. Slack, T. Wyant, and K. J. Lanfear.
Available from Br. of Distr., USGS 604 S. Pickett St. Alexandria, VA 22304 $3.25. Geological Survey Professional Paper 1227, 1981. 40 p, 13 Fig, 10 Tab, 35 Ref.

Descriptors: *Oil spills, *Risks, *Water pollution sources, *Computer models, Model studies, Monte Carlo method, Simulation analysis, Probability distribution, Leases, Oil pollution, Environmental effects, Ecology, Water pollution control, Path of pollutants, Public lands, *Outer Continental Shelf.

The U.S. Geological Survey has developed an oilspill risk analysis model to aid in estimating the environmental hazards of developing oil resources in Outer Continental Shelf (OCS) lease areas. The large, computerized model analyzes the probability of spill occurrence, as well as the likely paths or trajectories of spills in relation to the locations of recreational and biological resources which may be vulnerable. The analytical methodology can easily incorporate estimates of weathering rates, slick dispersion, and possible mitigating effects of cleanup. The probability of spill occurrence is estimated from information on the anticipated level of oil production and method of route of transport. Spill movement is modeled in Monte Carlo fashion with a sample of 500 spills per season, each transported by monthly surface current vectors and wind velocities sampled from 3-hour wind transition matrices. Transition matrices are based on historic wind records grouped in 41 wind velocity classes, and are constructed seasonally for up to six wind stations. Locations and monthly vulnerabilities of up to 31 categories of environmental resources are digitized within an 800,000 square kilometer study area. Model output includes tables of conditional impact probabilities (that is, the probability of hitting a target, given that a spill has occured), as well as probability distributions for oilspills occurring and contacting environmental resources within preselected vulnerability time horizons. (USGS)
W82-06145

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,
Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
For primary bibliographic entry see Field 5G.
W82-06147

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W82-06150

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
J. I. Waddington.
Water Pollutiion Control, Vol 80, No 2, p 149-162, 1981. 2 Tab, 21 Ref.

Descriptors: *Water pollution control, *Planning, Environmental protection, *Mediterranean Sea, Mediterranean Action Plan, International agreements, International commissions, Organizations, International law, Legal aspects, International waters.

By the year 1965 it was clear that many coastal reaches along the Mediterranean Sea were rapidly becoming affected by increasing pollution levels. Efforts to prevent further deterioration of the area were needed, along with significant steps to improve the situation. A great range of activities is now in progress at local, national, and international levels, having been catalyzed by the Mediterranean Action Plan. The plan was outlined less than six years ago at the Barcelona Convention. The political will to cooperate in safeguarding the resources of the Mediterranean has been amply demonstrated, and there are more solid grounds for optimism than would have seemed possible only a short time ago. A monitoring program is being carried out by networks involving 84 research centers in 16 Mediterranean states. Eleven components of this program were carried out in 1975-1980, including studies on monitoring of petroleum hydrocarbons, heavy metals, and chlorinated hydrocarbons; effects of pollutants, coastal pollutant transport, role of sedimentation, and pollutants from land-based sources. A priority action program is being implemented. (Baker-FRC)
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,
Louisiana Water Resources Research Inst., Baton Rouge.
S. M. Crane, and R. F. Malone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243742, Price codes: A07 in paper copy, A01 in microfiche. Report, June 1982. 123 p, 10 Fig, 7 Tab, 62 Ref, 8 Append. OWRT B-014-LA(1).

Descriptors: *Model studies, *Biochemical oxygen demand, *Streams, *Kinetics, *Statistical analysis, *Probabilistic process, Computer models, Mathematical studies, Mathematical models, Predictin, Statistical methods, Statistical models, Monte carlo method, Stochastic process, Water quality management, Water quality standards, Oxidation ponds, Effluent seepage.

Nineteen sets of observed biochemical oxygen demand (BOD) data were collected from a low-flow southern stream which received an oxidation pond effluent. These data were used to assess the predictive reliability of a modified BOD model (Dobbins) for the stream environment. A strong correlation was found between chlorophyll-a (an indicator of algal productivity) and BOD, indicating that most of the BOD was in the form of algae from the upstream pond discharge. The modified model, however, predicted BOD stream values unreliably. The stabilized value of the standard error (SE) of prediction was 5.9 mg/liter (44% of the mean BOD value), based on a simulation experiment using 12 calibration data sets. The Monte Carlo method and split-sample testing were used to assess model performance in the calibration and verificatin phases, with stochastically-converged values of the SE of estimate and prediction used as statistical measures of model performance in each phase, respectively. The amount of data was a critical factor for model calibration, but not for model verification. It was concluded that probabilistic models of BOD in streams are better suited for use in making water quality management decisions. (Zielinski-MAXIMA)
W82-06159

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Biology.
For primary bibliographic entry see Field 5C.
W82-06165

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,

Arkansas Univ., Fayetteville. Water Resources Research Center.
D. M. Chittenden, II.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254939, Price codes: A03 in paper copy, A01 in microfiche. Publication No 81, December 1981. 38 p, 7 Fig, 4 Tab, 18 Ref, 4 Append. OWRT A-050-ARK(1), 14-34-0001-0104.

Descriptors: *Radioactive wastes, *Nuclear reactors, *Cooling water, Adsorption, Water pollution sources, Nuclear power plants, Cooling, *Cesium radioisotopes, *Strontium radioisotopes, Cerium, Lake sediments, Suspended sediments, Alkaline-earth metals, Radiochemical analysis, Radioactivity techniques, Reservoirs, *Arkansas, Dardanelle Lake.

Concentration variations for strontium 90 (Sr90) and cesium 137 (Cs137) were analyzed at four stations in the Dardanelle Reservoir as functions of two parameters: the concentration of ionic species; and the activity released (AR) from the two 900 Mw reactors which use the Reservoir as a coooling water source. Multiple regression analyses were performed on the radionuclide concentrations using these two parameters as predictors. The results indicated that Sr90 is in equilibrium between solution and the suspended sediment, with the equilibrium position sensitive to changes in alkaline earth cation (M-II) concentrations. Hence, the M-II concentration has a substantial effect on Sr90 removal from the water column. On the other hand, the Cs137 concentration varied with AR, indicating that solution-sediment equilibrium has not been attained (since the time for newly-released Cs137 to equilibrate is greater than the mean water residence time in the Reservoir. Further, the Reservoir occurrence of cerium (Ce144 - praseodymium 144 seems a consequence of reactor refueling/maintenance, with Ce141 (and Ce144) derived from an airborne source with runoff to the Reservoir. (Zielinski-MAXIMA)
W82-06169

TRANSPORT OF PCBS IN AQUATIC LABORATORY MODEL ECOSYSTEMS FROM SEDIMENT TO THE ATMOSPHERE VIA THE SURFACE MICROLAYER,
Lund Univ. (Sweden). Limnological Inst.
A. Sodergren, and P. Larsson.
Ambio, Vol 11, No 1, p 41-45, 1982. 3 Fig, 8 Tab, 30 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Sediment-water interfaces, *Tubificids, *Midges, Aquatic animals, Lakes, Eutrophic lakes, Model studies, Anaerobic conditions, Particulate matter, Atmosphere, Jet drops, Surface microlayer, Sediment gas, *Sweden.

The effects of bottom-living organisms and anaerobic conditions on the distribution of PCBs in aquatic model ecosystems consisting of Chironomous plumosus and Tubifex sp. were studied. Sediment and water from the eutrophic Lake Havgardssjon in Sweden were incubated at 5 C and at 18 C with 2,3,4,4'-tetrachlorobiphenyl, 2,3',4,4'5-pentachlorobiphenyl and Clophen A 50, with the Clophen A 50 injected 5 mm (5 C) or 20 mm (18 C) below the sediment surface. Results showed a transport of PCBs to overlying water both in systems containing macroorganisms and in anaerobic systems. The presence of particles determined the amount of PCBs detected in the water. PCBs were taken up from sediment and accumulated in the macroorganisms. The accumulation was more pronounced when chironomids and tubificids were incubated together. PCBs left the water by jet drops and were recovered 7 cm above the water surface in all but fixed systems, the lowest amounts recorded being from undisturbed sediment cores. A similar pattern in anaerobic systems was caused by gas that developed in the sediment. The surface microlayers also contained PCBs, with the highest levels in very turbid anaerobic systems. PCBs moved toward the sediment surface in undisturbed cores incubated at 18 C. Incubation at 5 C rather than at 18 C produced a higher level of PCBs in water, animals, surface microlayer and jet drops. Surprisingly low amounts of PCBs were released to the water when injected at 20 mm, though low amounts were used. If these results apply to field conditions, the sediment may act as a source rather than a sink. (Gish-FRC)
W82-06180

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,
Mathes (John) and Associates, Inc., Columbia, IL.
For primary bibliographic entry see Field 5G.
W82-06185

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 2K.
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
P. A. Yeats, and J. M. Bewers.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 982-992, May, 1982. 2 Fig, 6 Tab, 45 Ref.

Descriptors: *Heavy metals, *Rivers, *St. Lawrence River, Path of pollutants, Aluminum, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Magnesium, Calcium, Silicon, Sediments, Canada.

Measurements of the dissolved and particulate forms of aluminum, iron, manganese, cobalt, nickel, copper, zinc, and cadmium made during a two year period at the mouth of the St. Lawrence River are reported. The sampling site was just upstream of the landward limit of salt intrusion. Some of the measurements taken were used to estimate metal fluxes for the purpose of determining the oceanic residence times of trace metals. Variability in the concentration of the dissolved metals was unrelated to changes in water flow or suspended load. Particulate Al, Fe, Mn, and Zn concentrations were related to water flow. The metal/aluminum ratios of particulate Mn, Cu, Zn, and Cd were elevated with respect to crustal rocks or coastal marine sediments, with the enrichment occurring in the nondetrital, or weak acid soluble, fraction. Annual dissolved metal discharges and nndetrital and total particulate metal discharges that take into account monthly variations in metal concentrations have been calculated for the St. Lawrence River. These calculated discharges are compared with estimates based on other rivers. The importance of nondetrital particulate metal fluxes is emphasized by these findings. (Baker-FRC)
W82-06190

RETENTION OF RIVERINE IRON IN ESTUARIES,
Maine University at Orono, Walpole.
L. M. Mayer.
Geochimica et Cosmochimica Acta, Vol 46, No 6, p 1003-1009, June, 1982. 7 Fig, 29 Ref.

Descriptors: *Estuaries, *Iron, Rivers, Seawater, Mixing, Maine, Salinity, Flocculation, Suspended sediments, Tannery effluents, Bottom sediments, Path of pollutants, Chemistry of precipitation, Chemical composition, Gulf of Maine, Canada.

Both the dissolved and particulate iron concentrations were examined in a series of estuarine water parcels, under low turbidity conditions, to determine whether iron removed from a filtrable state was actually lost from the water parcel. The potential roles of gravity and suspended sediment in removing iron from water parcels were examined by experimentation. The study area was the Gulf of Maine and three of itrs associated estuaries. The estuaries are all drowned river valleys, receiving freshwater runoff from watersheds similar in climate and vegetation. Riverine Fe was found to remain fairly conservative with salinity, implying that the process of flocculation does not necessarily remove Fe from water parcels. Laboratory experiments corroborated the field data by demonstrating that neither gravity nor suspended sediment was very effective in removing flocculated Fe from suspension. Input of a tannery effluent did appear to result in scavenging of Fe from estuarine waters. Flocculated riverine Fe was found to increase considerably the Fe concentrations of estuarine bottom sediments, with the amount of iron per sediment specific surface area dependent on mean river flow entering an estuary. While no long term retention efficiencies could be calculated for these estuaries, it seems likely that a significant portion of flocculated riverine Fe escapes to shelf waters. (Baker-FRC)
W82-06191

MERCURY CONTAMINATION OF THE LERDERDERG RIVER, VICTORIA, AUSTRALIA, FROM AN ABANDONED GOLD FIFLD,
Monash Univ., Clayton (Australia). Dept. of Chemistry.
B. M. Bycroft, B. A. W. Coller, G. B. Deacon, D. J. Coleman, and P. S. Lake.
Environmental Pollution, Series A, Vol 28, No 2, p 135-147, 1982. 3 Fig, 5 Tab, 25 Ref.

Descriptors: *Mercury, *Mine wastes, *Gold, Rivers, *Australia, *Lerderderg River, Water pollution sources, Sediments, Fish, Path of pollutants, *Mine wastes.

This paper reports the distribution of mercury in water, sediments and fish from the Lerderderg River and the relationship between mercury levels and gold mining activities around Blackwood, where alluvial gold was first discovered in 1851. It has been at least 50 years since direct amalgamation was used routinely on the blackwood field. The Lerderderg River rises on the southern edge of the Great Dividing Range, about 110kkm northwest of Melbourne, Australia. State forest covers most of the catchment. The river flows in a southeasterly direction, passing through the settlements of Blackwood and Darley before joining the Werribee River. Recently a weir and a diversion tunnel were constructed on the river to divert water from the upper Lerderderg to Merrimu Reservoir, which supplies drinking and irrigation water to surrounding districts. Water, sediment and fish samples were collected from sites along the Lerderderg River and tributaries with sampling points focused around Blackwood. Mercury levels in water ranged from 0.01 to 0.31 micrograms/liter. Mercury levels in sediments ranged from less than 0.02 to 68.50 micrograms/gram dry weight, with an additional reading of 120.00 micrograms/g at a tailings sump on the bank of Yankee Creek. Mercury levels in brown trout ranged from 0.03 to 0.35 micrograms/g and for river blackfish, from 0.03 to 0.64 micrograms/g. The mercury levels in water samples showed no clear correlation with sampling sites. Sediment levels revealed a clear correlation with past mining activities. (Baker-FRC)
W82-06194

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,
North Dakota State Univ., Fargo. Dept. of Bacteriology.
For primary bibliographic entry see Field 5D.
W82-06195

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,
Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.
B. J. Richardson, and J. S. Waid.
Search, Vol 13, No 1/2, p 17-25, February/March, 1982. 3 Fig, 6 Tab, 50 Ref.

Descriptors: *Waste disposal, *Hazardous materials, *Polychlorinated biphenyls, *Australia, Organic compounds, Incineration, Waste dumps, Environmental effects, Mining industry, *Water pollu-

tion sources, Ports, Bays, Mussels, Sediments, *Path of pollutants.

The major routes of environmental entry of polychlorinated biphenyls (PCBs) include vaporization from open burning or incomplete incineration of solid wastes, and from paints, coatings and plastics; leaks and disposal of industrial fluids by improper means, including contamination of sewage which may ultimately be dumped at sea or on land; disposal on dumps and landfills, with subsequent leaching and volatilization; and inclusion in pesticides. In Australia the use of PCBs as hydraulic fluids in the mining industry is allowable, dispite risks of escape, especially in the marine situation such as drilling on coral reefs. The available evidence for the presence of PCBs in soils, sedimens and waters in Australia is very meager. The distribution of PCBs in sediments, fish and molluscs from Australian coastal waters is under investigation. In 1978 it was noted that PCBs had been found in mussels taken from Corio Bay. Mussel samples were then taken from Port Phillip and Corio Bay, with the result that PCBs were present in every sample, highest concentrations being found in localities adjacent to industrial activity or with heavy shipping traffic. The results of sediment analysis reinforced the mussel data. The greatest potential threat lies in delay in tackling the problem of finding efficient ways to destroy PCBs. A large quantity of PCBs awaits disposal under inadequate storage methods. (Baker-FRC)
W82-06232

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman, T. B. Ridder, H. F. R. Reijnders, and J. Slanina.
Water, Air, and Soil Pollution, Vol 17, No 4, p 415-420, 1982. 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Chemical composition, *Rain, Birds, Contamination, Chemical analysis, Phosphates, Nitrates, Potassium, Ammonia, Sampling, Precipitation, *Netherlands, *Pollutant identification.

Problems caused by bird-droppings in precipitation chemistry experiments in the Netherlands are discussed. Two specific projects are discussed, each of which used a collector consisting of a polyethylene funnel. The rim of the funnel was at 1.50 meters above the ground and the internal diameter was 22.3 cm. Each day during sampling for one of the projects the samplers were inspected for bird excrement, which was then carefully removed and the funnel cleaned with demineralized water. Even so, bird excrement may enter the bottle without being noted, particularly during rainy weather. In the two year period of the study, a total of 67 bird-droppings were counted. In the autumn of 1978 the samplers were equipped with a bird scarer device which did cut down on the number of droppings recorded. During the second project the collection bottles were changed once a week, the number of bird-droppings was counted and the collector was carefully cleaned. The pH of the rainwater was influenced by the droppings; in all cases except one the samples became more alkaline. An analysis of six bird-droppings revealed that the chemical composition of the rainfall collected is influenced most heavily in the amount of phosphates, potassium, and ammonia present. In some cases nitrates can also be influenced. To check on the possible occurrence of bird-droppings it is suggested that the phosphate content of the precipitation samples be checked. (Baker-FRC)
W82-06245

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W82-06269

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06270

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,
Northern Michigan Univ., Marquette. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,
Alberta Univ., Edmonton. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06272

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. D. Brock, D. R. Lee, D. Janes, and D. Winek.
Water Research, Vol 16, No 7, p 1255-1263, July, 1982. 2 Fig, 8 Tab, 18 Ref.

Descriptors: *Cycling nutrients, *Groundwater, *Lakes, Nitrogen, Ammonia, Phosphorus, Eutrophication, Lake Mendota, *Wisconsin, Drainage area, Intersitial water.

Results of the first pore water nutrient assays at locations of known groundwater inflow in a lake are presented. Seepage water was assumed to be equivalent to the sediment pore water in the sediments lying just below the sediment-water interface. Lake Mendota has a fairly regular shoreline, and its shallow sediments are composed of sand which is fairly uniform. A total of 107 separate measurements at different locations were made around the Lake and used to calculate seepage rate. A total of 20 separate samplings for chemical analysis of seepage water were done at 11 separate sites around the lake. Phosphorus concentrations in seepage water varied from a low of 10 to over 500 micrograms/liter. Nitrate values varied from about 50 to 1000 micrograms/liter of nitrate-N. Ammonia values ranged from a low of 50 to a high of 400 micrograms/liter ammonia-N. These findings indicate that groundwater can be a significant source of water to a drainage lake, accounting for about 1/3 of the inflowing water in Lake Mendota. Groundwater can also be a route of nutrient loading to a drainage lake, especially for P. Seepage was continuously high in P and ammonia and lower in nitrate than well, spring or surface water, suggesting that the P and ammonia of seepage might be derived from the lake itself rather than from the surrounding land. (Baker-FRC)
W82-06285

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,
North West Water Authority, Warrington (England).
F. Jones.
Water Science and Technology, Vol 14, No 3, p 61-70, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Bacteria, *Ocean dumping, *Sludge disposal, Fate of pollutants, Water pollution sources, Wastewater disposal, Self purification, Coliforms, Fylde Coast, Liverpool Bay, North Wirral, Beaches, Outfalls, *England.

Bacterial concentrations in marine waters receiving sewage sludge were documented at three locations in northwest England. Untreated sewage discharged through the 3-mile North Wirral outfall at Meols did not cause high bacterial levels at beaches in the immediate area. Total coliforms ranged from 1000-585- per 100 ml at six stations about 9 km east of the outfall to 10-220 per 100 ml at the other 15 stations closer to the outfall. Offshore samples ranged from 7120 per 100 ml total coliforms at the outfall to 40-39- per 100 ml at distances 1 and 2 km on all sides of the outfall. In Liverpool Bay total coliforms were 27 per 100 ml at the ship dumping site and 13,580 per 100 ml at the mouth of the River Mersey. Six outfalls along a 25 km stretch of coast produced high and variable bacterial levels (1000-114,000 per 100 ml) at beaches at Fleetwood near the River Wyre. In this area occasional high turbidity greatly inhibits the natural purification process. (Cassar-FRC)
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,
Camp, Dresser and McKee Inc., Boston, MA.
For primary bibliographic entry see Field 5E.
W82-06289

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5C.
W82-06304

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,
Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
D. T. Pentek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256512, Price codes: A04 in paper copy, A01 in microfiche. MA Thesis, May 1981. 57 p, 72 Ref. OWRT B-017-CT (1).

Descriptors: *Ozonolysis, Polyhalogenated aromatic compounds, *Dibenzofuran, Industrial wastes, *Chemical wastes, Effluents, Oxidation, Wastewater treatment.

Ozonolyses of dibenzofuran were carried out in methylene chloride with reductive work up at -23 C, O C and 14 C, and in water at 14 C. Pseudo first order and second order rate constrants were calculated for all reactions. The second order rate constant in water was k sub 2(H O) = 1000M(-1)s(-1) and in methylene chloride was k sub 2 = 0.88M(-1)s(-1). The three orders of magnitude difference is thought to be caused by a competing free radical mechanism for dibenzofuran occurring in water. Oxidation products identified from the ozonolysis of dibenzofuran in methylene chloride were: salicylic acid, carbon dioxide, glyoxal, formaldehyde, and oxalic acid. A percentage of 40 of the initial carbon present in dibenzofuran is accounted for. The major product is salicylic acid and the major pathway for ozonolysis of dibenzofuran proceeds through salicylic acid. A total of 3.5 mmole ozone/mmole dibenzofuran was required to degrade 99% of the dibenzofuran present (in methylene chloride).
W82-06305

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and E. A. Leggatt.
Water Research, Vol 16, No 7, p 1217-1222, July, 1982. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Water quality, *Bacteria, Lakes, Recreational facilities, Coliforms, Fecal bacteria, Bioindicators, Pollutant identification, Indicators, Canada, *Ontario.

Present bacteriological water quality was documented for a number of developed recreational lakes and for one undeveloped lake in the Ontario area. This was achieved by determining the density and distribution of fecal bacteria and the location and sources of major inputs of fecal indicator bacteria in these lakes. Lakes were surveyed for 5 consecutive days, in the spring, summer and often the fall of the year, at inflows, outflows and a

number of locations representative of shoreline features and development. Fecal coliform and fecal streptococcus levels in the 18 developed lakes samples varied in a seemingly erratic way. When the bacterial densities at different points on the lake were examined by an analysis of variance, the locations with significantly higher densities of fecal coliforms and fecal streptococci were most often along the cottaged shoreline. Total coliform densities did not show this relationship. In addition, after rainfall, a large increase in the numbers of fecal coliforms were found in the cottaged lakes but not in the uncottaged lake. These findings suggest that the cottaged shoreline was a greater source of fecal indicator bacteria than the uncottaged shoreline. However, the highest concentrations of fecal indicator bacteria in these lakes were found in the inflowing streams. The bacteria in these streams arose from stormwater from undeveloped forested watersheds and were probably of soil or animal origin. (Baker-FRC)
W82-06310

ACID RAIN MODEL: HYDROLOGIC MODULE,
Tetra Tech. Inc., Lafayette, CA.
C. W. Chen, J. D. Dean, S. A. Gherini, and R. A. Goldstein.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 455-472, June, 1982. 12 Fig, 5 Tab, 22 Ref.

Descriptors: *Acid rain, *Model studies, Watersheds, Catchment areas, Drainage area, Basins, Percolation, Chemical analysis, Lakes, Chemical reactions, Evapotranspiration, Freezing, Snowmelt, Melting, Hydrology, Hydrologic models.

An Integrated Lake-Watershed Acidification Study (ILWAS) model is presented and findings based on simulation applications of the model to date are evaluated. The ILWAS model includes hydrologic, canopy chemistry, snowmelt chemistry, soil chemistry, and stream and lake water quality modules. For modeling purposes a drainage basin is divided into terrestrial subcatchments, stream segments, and a lake. Vertically, each subcatchment is further segmented into canopy, snow pack, and soil layers. The lake is also vertically layered. All these physical compartments are coupled to form a network that allows water to be routed through the system to the lake outlet. The physical compartments are described by geometric input parameters such as area, aspect, slope, and soil layer thickness. Subcatchments are allowed to have different percentage distributions of deciduous and coniferous trees and open areas. The hydrologic module of the ILWAS model realistically simulated the total outflow from a lake basin and the hydrology of the subcatchments. The flowpath calculations are supported inn part by observations of the soil solution and lake water pH values. The flowpaths of rain and snowmelt water through the terrestrial system are important factors in determining the susceptibility of lakes to acidification by atmospheric deposition. Several mechanisms can force rain and snowmelt water to become lateral flow in the upper soil horizons instead of percolating into the inorganic horizons.Low hydraulic conductivity in any soil layer may result in lateral flows in overlying layers. (Baker-FRC)
W82-06360

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,
Vermont Water Resources Research Center, Burlington.
For primary bibliographic entry see Field 5G.
W82-06372

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 205, March, 1980. 44 p, 1 Fig, 19 Tab, 6 Ref.

Descriptors: *Trace metals, Water analysis, *Water pollution sources, *Sediment-water interfaces, Heavy metals, Pollutants, Pollutant identification, Estuaries, *South Africa, Rivers, Nonpoint pollution sources, Toxicity, Chemical analysis, Water quality, Sediments, Metals, Water quality control, Cores, *Path of pollutants.

Trace metal surveys were conducted during July 1978 on three estuaries which enter the Indian Ocean in Mossel Bay. Surface sediment, water, and sediment core samples were collected at selected sites in each river for trace metal analyses (13 elements for water samples; 16 elements for all other samples) by atomic absorption spectroscopy. Inter-element relationships and absolute metal concentrations were examined before interpreting the resultant data. The results indicate that all three rivers experience some degree of metal contamination. However, with the exception of the extremely high chromium levels (containing up to 1.13% chromium) found in sediment in part of one river (Great Brak) from an unknown source, trace element concentrations were found not to represent a significant pollution threat; nonetheless, monitoring should be continued. All three rivers exhibited some indications of other than natural metal buildup. The chromium anomaly will be resurveyed in more detail for potential source identification. Remobilization of the chromium contamination via flooding could induce mass mortality of local flora/fauna. Trace element concentrations are given for all sample types and correlation matrices are given for the core samples. (Zielinski-MAXIMA)
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,
National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 2L.
W82-06388

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,
Karlsruhe Univ. (Germany, F.R.).
W. Rodi, and K. Weiss.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 737-746, June, 1982. 7 Fig, 4 Ref.

Descriptors: *Heated water, *Thermal pollution, *Mixing, Fate of pollutants, Flow characteristics, Open channel flow, Water temperature, Buoyancy.

Heated water was discharged coaxially into rectangular open channel flow from a slot placed at the channel center. The discharge and channel velocities were the same. The temperatures studies were 9 and 20 C in excess of ambient. Temperature distribution was determined by thermistors, and surface motions was recorded by photographing surface floats. Several effects associated with the density differences between heated and ambient water were visible. The warm water spreading at the surface formed a warm surface layer and isolated warm water pools. Colder ambient water was drawn toward the center plane to replace the warm water. The warm water spreading at the surface formed a sharp straight front with an angle to the center line that increased with increasing density differences. The warm surface layer dampened the turbulent mixing with the colder water, so the isolated warm water pools stayed hot for considerable distances from the discharge. The flow geometry investigated here was simple enough to use as a test case for calculation procedures simulating buoyancy effects on mean flow and turbulent mixing. (Cassar-FRC)
W82-06422

GROUNDWATER POLLUTION FROM INDUSTRIAL WASTE DISPOSAL, A CASE STUDY,
Saint Lawrence Univ., Canton, NY.
G. R. Harris, C. Garlock, L. LeSeur, S. Mesinger, and R. Wexler.
Journal of Environmental Health, Vol 44, No 6, p 287-295, May/June, 1982. 10 Fig, 7 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Waste disposal, *Water pollution sources, *Land disposal, *Leaching, *Groundwater movement, Waste management, Wastes, Industrial wastes, Geohydrology, Soil types, Leachates.

An organic and inorganic waste disposal pit operated by Sealand Restoration Incorporated (SRI) of Oswego, New York, was improperly constructed and violated state permits. The pit was not lined with impermeable materials, and an underlying groundwater interception ditch was too shallow, resulting in area groundwater pollution. Following periods of high precipitation, migration of leachate was observed at downgradient sampling sites. Minimum geologic and hydrologic considerations for industrial waste disposal sites include soil type, depth to groundwater and bedrock, slope, and distance to surface water. According to these criteria, the existing disposal pit was found to have severe limitations for the disposal of industrial wastes. Investigations into the suitability of other SRI sites for waste disposal were inconclusive due to insufficient characterization of soil and land properties. (Geiger-FRC)
W82-06434

EXAMINATION OF PROBABLE CAUSES OF INDIVIDUAL WATER SUPPLY CONTAMINATION,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
W. S. Brewer, and J. Lucas.
Journal of Environmental Health, Vol 44, No 6, p 305-307, May/June, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Coliforms, *Groundwater pollution, *Aquifers, *Infiltration, *Wells, Fate of pollutants, Water pollution sources, Percolation, Groundwater recharge, Water supply, Mathematical studies, Surveys.

A previous study of water supply records from 1972-1975 in a rural county in Ohio revealed a correlation between the probability of contamination and the location of wells with respect to their supply aquifers. To test the validity of the hypothesis that contaminated aquifers were the cause of high coliform levels in wells, county records from 1978-79 were surveyed to determine the extent of contaminated wells in each of two aquifers serving the county. Of the 613 wells surveyed, 113 wells were found to have coliform counts greater than 1 colony/100 milliliters. Comparison of contamination rates showed that one aquifer was more likely to contain contaminated wells than the other, but efforts to establish a causal relationship were unsuccessful. Analysis of variance showed that the formations overlying the well (depth, consolidated or unconsolidated strata, surface water infiltration rate) exerted a stronger influence on the outcome of the study than did the aquifer correlation. A cause-effect relationship was proposed between insufficient filtration of percolating surface water and contamination. (Geiger-FRC)
W82-06435

NOMOGRAPHS FOR RAPID SOLUTIONS FOR THE STREETER-PHELPS EQUATIONS,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Div.
G. B. McBride.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 378-384, April, 1982. 5 Fig, 7 Ref.

Descriptors: Mathematical equations, *Nomographs, *Rivers, *Water pollution sources, Biochemical oxygen demand, Dissolved oxygen, Mathematical models, Prediction, *Streeter-Phelps equations, *Path of pollutants.

Nomographs have been developed which allow rapid calculation of the worst effects of emergency discharges for rivers for which a convenient operational model does not already exist. The nomographs are based on the equations of the Streeter-Phelps model, which allow calculation of the concentrations of river biochemical oxygen demand (BOD) and river dissolved oxygen deficit (DOD) downstream of some initial point at which BOD

and DOD values are known. Solutions for the location and magnitude of the maximum downstream river DOD are presented in simple nomograph form. A nomograph for calculation of the maximum permissible initial river 5-day BOD given the initial river DOD and the maximum permissible downstream DOD is also presented. The use of these nomographs involves three simple steps: the formation of three dimensionless ratios, the reading of a nomograph, and the calculation of the required answer by a simple arithmetic formula. Use of the nomographs requires the following data: initial river DOD in grams per cubic meters the BOD decay coefficient evaluated for the standard laboratory BOD test, the river deoxygenation coefficient, and the river reaeration coefficient. The nomographs can only be strictly applied to rivers which comply with the requirements of the Streeter-Phelps model, although they will provide reasonable predictions for most rivers when rapid and approximate answers are required. (Carroll-FRC)
W82-06460

PCB UPTAKE BY FIVE SPECIES OF FISH IN LAKE MICHIGAN, GREEN BAY OF LAKE MICHIGAN, AND CAYUGA LAKE, NEW YORK,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen, S. A. Spigarelli, and M. M. Thommes.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 700-709, May, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Fate of pollutants, Model studies, Fish, *Uptake, *Polychlorinated biphenyls, Trout, Salmon, Whitefish, *Lake Michigan, Absorption, Accumulation, Metabolism, Habitats, Kinetics, Path of pollutants, *Green Bay, *Cayuga Lake, Wisconsin, New York.

A bioenergetic model was used to describe the uptake of polychlorinated biphenyls (PCBs) by trout, whitefish, and salmon of Lake Michigan and trout of Cayuga Lake in New York. PCB uptake was defined in terms of metabolism, food consumption, size, and growth. PCB levels differed significantly among species according to habitat. PCB was taken up by brown trout in a pattern distinct from that of other species. An increase in the exponent of weight for metabolism changed the shape of the relation between PCB concentration and body weight from asymptotic to non-asymptotic. In all species tested except brown trout, PCB uptake was not asymptotic and concentrations did not approach equilibrium. Simulation analyses showed that differences in PCB levels among species and in the same species among different habitats were most likely due to differences in metabolic parameters, exposure, size, and rate of growth. (Geiger-FRC)
W82-06493

ENRICHMENT OF INORGANIC NUTRIENTS IN THE INNER SARONIKOS GULF (1973-1976),
Institute of Oceanographic and Fisheries Research, Athens (Greece).
M. Friligos.
Marine Pollution Bulletin, Vol 13, No 5, p 154-158, 1982. 1 Fig, 7 Tab, 11 Ref.

Descriptors: *Nutrients, *Wastewater pollution, Fate of pollutants, Water pollution sources, Saronikos Gulf, Elefsis Bay, *Greece, Outfalls, Nitrates, Nitrites, Ammonium, Silicates, Phosphates, Wastewater disposal, Ocean disposal, Wastewater outfall.

Waters in the Inner Saronikos Gulf and Elefsis Bay, near Athens, Greece, were sampled during 16 cruises January 1973 to September 1976. The semi-enclosed Gulf is 70-90 m deep in the eastern main body and 130-400 m deep in the western portion. An outfall discharges raw sewage from the Athens metropolitan area into the sea water of the Inner Gulf. The 30 m deep Elefsis Bay, at the north end of the Gulf, is connected by two narrow and shallow channels to Keratsini Bay and the Saronikos Gulf. It is polluted with industrial effluents and sewage. Background levels (in micrograms atoms per liter) of nutrients in the relatively unpolluted Outer Bay were: phosphate-P, 0.12; silicate-Si, 1.22; nitrite-N, 0.16; nitrate-N, 0.42; and ammonium-N, 0.36. Concentrations of nutrients in the Inner Gulf were 2.5 times the background level for phosphate, 1.39 for silicate, 1.55 for nitrite, 2.60 for nitrate, 4.10 for ammonium, and 3.03 for total N. Elefsis Bay contained 9 times the inoganic N, 15 times the ammonia, 7 times the nitrates, 3 times the nitrite, 5 times the phosphate, and 4 times the silicate as the background. (Cassar-FRC)
W82-06499

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Artiola-Fortuny, and W. H. Fuller.
Soil Science, Vol 133, No 4, p 218-227, April, 1982. 4 Fig, 6 Tab, 22 Ref.

Descriptors: *Leachates, *Phenols, Landfills, Sanitary landfills, Organic compounds, Municipal wastes, Chemical reactions, Adsorption, Clays, Aeration, Humic acids, Fulvic acids, Fate of pollutants.

Municipal solid waste leachates contained varying amounts of natural phenols, depending on age. The youngest leachate, 1 year, was higher in acidity, total organic carbon, and electric conductivity (EC) than leachates aged 3 to 7 years. Over a 12 month sampling period all leachates decreased in total organic carbon. The youngest leachate increased in pH and EC, while the older leachates remained constant in pH and EC. Natural phenols migrated through 10 cm of clay soils in 7 pore volume displacements or fewer. Leachates of low pH and high total organic carbon moved rapidly through the soil. Phenols moved more slowly in fine textured, iron oxide-rich clays than in other soils. Leachates enriched with phenol, 2,6-dimethylphenol, o- and p-cresol, 2,4-dichlorophenol, and p-nitrophenol were more reactive with younger leachates than with older ones. The high level of humic and fulvic acids in younger leachates appeared to be correlated with the rapid reaction of phenols. Of all the phenols tested, the strongly polar nitrophenols were least reactive with leachates. Phenol levels were rapidly reduced by aeration of leachates. (Cassar-FRC)
W82-06518

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,
National Board of Waters, Helsinki (Finland).
R. M. Niemi, S. Knuth, and K. Lundstrom.
Applied and Environmental Microbiology, Vol 43, No 2, p 378-388, February, 1982. 8 Fig, 5 Tab, 28 Ref.

Descriptors: *Actinomyces, *Fungi, Thermophilic bacteria, Mesophytes, Water supply, Lakes, Rivers, Water treatment, Bacteria, Finland, Drinking water, Path of pollutants, Filtration, Disinfection, Artificial recharge, Groundwater pollution.

The occurrence of mesophilic and thermophilic actinomycetes and fungi in finnish lakes and rivers used as water supplies and in treated water and distribution systems was investigated. Mesophilic fungi and actinomycetes were common in Finnish lakes and rivers used as water supplies, while thermophilic fungi and actinomycetes were present only in low concentrations. Eutrophic and mesotrophic lakes had higher concentrations of fungi and actinomycetes than did oligotrophic lakes. Thermophilic actinomycetes and fungi and mesophilic actinomycetes were more abundant in river water than in lake water. The correlation between concentrations of actinomycetes and fungi and the chemical and physical parameters of the water, as well as the correlations between microbes and the percentage of cultivated land in the drainage basin, probably reflect the importance of runoff for the occurrence of these microbes in lakes and rivers under normal conditions. A comparison of the efficiencies of different water treatments in removing these organisms showed that while chemical coagulation removed actinomycetes and fungi efficiently, sand filtration sometimes contributed to the populations of thermophilic actinomycetes. Actinomycetes and fungi were present in many raw water supplies and were able to pass through both sand filtration and disinfection, resulting in the occurrence of these bacteria in drinking water. Also, mesophilic actinomycete concentrations were higher in artificial groundwater produced for groundwater recharge than they were in eutrophic raw water. (Carroll-FRC)
W82-06543

CORRELATIONS BETWEEN PREDOMINANT HETEROTROPHIC BACTERIA AND PHYSICOCHEMICAL WATER QUALITY PARAMETERS IN TWO CANADIAN RIVERS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Applied and Environmental Microbiology, Vol 43, No 2, p 269-283, February, 1982. 2 Fig, 13 Tab, 42 Ref.

Descriptors: *Heterotrophic bacteria, *Bacterial analysis, *Physicochemical properties, Water quality, Bacteria, Factor analysis, Population dynamics, Rivers, *Canada, Dunbar River, Meduxnekeag River, Saint John River, Water pollution effects.

A multivariate statistical analysis of data from two branches of the Saint John River in New Brunswick, Canada, was performed to investigate the interactions of the bacterial populations with the physicochemical parameters of the water. One of the branches, the Dunbar, is a pristine woodland stream, while the other, the Meduxnekeag River, is a larger stream receiving some domestic and agricultural wastewaters. The heterotrophic bacterial populations of the two streams were analyzed as total heterotrophic counts; as species numbers, using numerical taxonomy; by diversity indices; and by factor analysis. Factors which profiled the bacterial community and which were common to both rivers included, in order of decreasing importance, fermentative metabolism, inorganic nitrogen metabolism, fluorescence-oxidative metabolism, and lack of starch hydrolysis. The correlations found between the bacterial populations and physicochemical parameters of the water suggested an intricate algal-bacterial interaction. In one river, correlation of the oxidative metabolism factor with rainfall suggested that the oxidative bacteria may be washed into the river from the surrounding land. The oxidative-fermentative factor correlated negatively with sunshine in the second river. While factor analysis was found to be the most effective method for revealing correlations between bacterial characteristics and the environmental parameters, the use of a variety of methods provided more insight into the ecological apsects. (Carroll-FRC)
W82-06544

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
For primary bibliographic entry see Field 2L.
W82-06546

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,
Agriculture Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W82-06547

SELECTION OF WASTE DISPOSAL SITES,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W82-06550

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,
Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
S. A. Telang, B. L. Baker, J. W. Costerton, T. Ladd, and R. Mutch.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 101, 1982. 101 p, 66 Ref, 5 append.

Descriptors: *Marmot, basin, *Alberta, Rocky Mountains, *Biogeochemistry, *Organic compounds, Drainage, Basin, Stream basins, *Mountain basins, Water Quality, Stream organics, Organic loading, Streamwater, Stream flow, *Path of pollutants.

The Marmot basin is a mountain drainage basin in the eastern slopes of the Rocky Mountains 600 km north of the Canadian-United States border. It illustrates the hydrology of eastern slopes drainage. The present study focussed on biogeochemical processes occurring naturally in the waters of Marmot creek. These were revealed by measurements of the transport and conversion of organic substances in that cold, clear mountain stream just below the alpine tree-line. Naturally-occurring organic substances ranged widely in biogeochemical lability and afforded a comprehensive evaluation of the in-stream processes of change. Organic substances of the streams are in a dynamic state with marked processes of transfer and conversion discernible in a short, 2.2 km, section of the Marmot system even under winter conditions. Detailed calculations based on stream monitoring revealed the effects of those processes by comparing mass transport in and out of the 2.2 km test section. Processes of conversion and transport within the test section were apparent for each compound and group of compounds. Three different seasonal patterns of alterations are noted. Processes of change involve biosynthesis, maceration and leaching, oxidation, up-take, photodegradation, mineralization, absorption/desorption and biodegradation. Some processes were related to land disturbance, as in the case of forest clear-cutting; this modified contributions to the stream from soil leaching. At the biogeochemical frontiers, three new approaches involved adaptation of anlytical technologies from related disciplines; 1) carbon preference indices for n-alkanes in the stream water clearly showed in-stream biosynthesis of hydrocarbons in the low-molecular weight range and the leaching of terrestrial hydrocarbons in higher mass ranges; 2) heterotrophic-potential measurements carried out in-situ and in thelaboratory confirmed the up-take of labile organic compunds in the stream (attributed largely to sessile rather than planktonic microbes); and 3) analogue-depletion calculations showed the potential of this method for evaluating stream processes when stream gauging is not available. The adoption of naturally-occurring inorganic ions as reference substances in the stable-labile system of depletion led clearly to a sharp definition of in-situ depletion. It is now possible (a) to use heterotrophic-potential experiments to predict the depletion of a given microbial substrate in a stream depletion, without the addition of tracers or the gauging of the stream. (WATDOC).
W82-06569

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,
Canada Centre for Inland Water, Burlington (Ontario).
W. Boutot, and T. A. Clair.
Technical Bulletin No 121, 1981. 23 p, 5 Fig, 5 Tab, 7 Ref.

Descriptors: *St. Croix River, *New Brunswick, *Maine, *Hydraulic models, *Oxygen levels, Water quality, Mathematical models, Pollutant loads, Salmon migration, Calibration, Model simulation, Data analysis, *Dissolved oxygen.

Mathematical modelling techniques have been applied to study the dissolved oxygen concentration in the lower reach of the St. Croix River. A hydraulic routing model, HEC-2, was used to describe the flow regime, and the WATQUAL moddel was used to simulate dissolved oxygen levels under different conditions of temperature, flow and biological oxygen demand. The results indicate that waste loading to the river should be restricted during periods of high temperature and minimum river discharge in order to permit fish migration. (WATDOC)
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
V. T. Chacko, B. C. S. Chu, and W. D. Gummer.
Scientific Series No 128, 1981. 12 p, 10 Fig, 3 Tab, 17 Ref.

Descriptors: *Red River(of the North), *Saskatchewan, *Minnesota, *Load distribution, *Seasonal ratios, *Nitrogen, *Phosphorus, Nitrate concentrations, Amonia, Species, Runoff.

The Red River flows from the United States through Manitoba and into the south basin of Lake Winnipeg. Significant seasonal variations in nitrogen and phosphorus species, concentration and ratios occurred in the Red River during a study conducted at the border between Canada and the United States. Nitrate-N was as much as 60% of total-N during the spring high flow. During summer nitrate-N was so low that it might have been a limiting factor for phytoplankton growth (the inorganic-N to ortho-P ratio exceeded 10 on one occasion only). Particulate-N was usually less than 30% of total-N. Ammonia was up to 30% of total-N in February. The ortho-P concentration constituted between 25% and 80% of total-P. Dissolved organic-P never exceeded 16% of total-P, and particulate-P was as much as 70% of total-P. Particulate P:N:C ratios differed from the stoichiometric ratios of plant cells. On this basis, it is concluded that much of the particulate-P was in mineral form. (WATDOC)
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 72, 1981. 10 p, 2 Fig, 9 Tab, 4 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, Water quality control, Contamination, Spiked samples, Homogeneity, Pollutant levels, Interlaboratory studies, Statistical analysis, Data collections, *Path of pollutants, *Pollutant identification.

This report describes an interlaboratory study on the analysis of polychlorinated biphenyls (PCBs) in naturally contaminated dry sediment reference materials and in isooctane solutions. The quality of data submitted by the participants varied widely. Among the more comparable laboratories, the average interlaboratory coefficient of variation (C.V.) of the sediment samples is 29.0%. This result is significantly worse than the interlaboratory C.V. (16.2%) on sediment samples spiked with PCBs, as reported in interlaboratory quality control study No. 25. The less reliable PCB results, as found on real sediment samples, are likely due to problems in recovery, interference and quantitation of PCB mixtures. (WATDOC)
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06575

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5A.
W82-06577

EFFECTS OF PH, TEMPERATURE, AND EH ON THE UPTAKE OF CADMIUM BY BACTERIA AND AN ARTIFICIAL SEDIMENT,
Ohio State Univ. Columbus. Dept. of Microbiology.
J. A. Titus, and R. M. Pfister.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6 p 697-704, June, 1982. 2 Fig, 2 Tab, 8 Ref,OWRT A-042-OHIO Grant 712437.

Descriptors: *Fate of pollutants, *Adsorption, *Hydrogen ion concentration, *Sediments, *Pseudomonas, Path of pollutants, Temperature, Uptake, Heavy metals, *Cadmium, Conductivity, Water temperature, Oxidation-reduction potential, Laboratory studies.

Bacteria are known to facilitate the movement of heavy metals from sediment to the water column during their metabolic activities. Acid production by bacteria also aids in the breakdown of the sulfides of zinc (Zn), cadmium (Cd) and lead (Pb). The adsorption of Cd by a Cd-resistant bacterium (Pseudomonas sp.) and a sediment matrix under various conditions of pH, temperature and Eh (redox potential) was examined in four separate kettles. Uptake of Cd by the artificial sediment matrix in a water-sediment system was related to the incubation conditions in a manner similar to that found with bacteria. After 4 days at pH 7 and a temperature of 35 degrees, Cd adsorption was greatest by sediment and bacteria. Incubation at a higher pH lowered sediment adsorption, while lowering the Eh resulted in higher 2-day Cd adsorption by sediment. These effects were less pronounced in bacteria. The amount of Cd taken up by bacteria averaged about 10 times greater than that adsorbed by the sediment on a dry weight basis. These studies showed that the uptake of Cd by a Cd-resistant bacterium was influenced by environmental factors in the same manner as that by sediment. (Geiger-FRC).
W82-06580

RELATIONSHIP OF WATER QUALITY AND POLLUTANT LOADS TO LAND USES IN ADJOINING WATERSHEDS,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
R. C. Ostry.
Water Resources Bulletin, Vol 18, No 1, p 99-104, February, 1982. 1 Fig, 6 Tab, 3 Ref.

Descriptors: *Water quality, *Pollution load, *Land use, Water pollution sources, *Watersheds, *Ontario, Grand River, Sangeen River.

The Grand and Saugeen Rivers in southern Ontario, Canada, were selected for investigation as pilot watersheds under the Pollution from Land Use Activities Reference Group study. These watersheds, which have adjacent headwater areas, are physically similar in geology, physiography, and climate. Land use and population constitute the major differences between the two watersheds and appear to be responsible for the significant differences in water quality between the watersheds at their outlets. The major pollution sources in the two watersheds were identified as trace elements from urban runoff and point source discharges, phosphorus from agricultural and urban runoff and private waste disposal, chloride from transportation corridors, and sediment and nitrogen from agricultural runoff. Suspended sediment loadings were similar for the two watersheds at their outlets, while all other unit area loads were higher in the Grand River than in the Saugeen River. Phosphorus, nitrogen, chloride, and lead loadings were

two to three times as high in the Grand River as in the Saugeen River. The higher phosphorus and nitrogen levels in the Grand River were attributed to larger point source inputs and to the higher proportion of agricultural activity in the Grand River basin, while the higher chloride and lead levels were attributed to the higher proportion of urban lands in the Grand River basin as compared to the Saugeen River basin. (Carroll-FRC)
W82-06587

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,
Thames Water Authority, London (London).
For primary bibliographic entry see Field 5E.
W82-06592

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,
For primary bibliographic entry see Field 5E.
W82-06599

PROPORTION OF METHYLMERCURY TO THE TOTAL AMOUNT OF MERCURY IN RIVER WATERS IN CANADA AND JAPAN,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
A. Kudo, H. Nagase, and Y. Ose.
Water Research, Vol 16, No 6, p 1011-1015, June, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Mercury, Rivers, Natural waters, Wastewater, Water analysis, *Methylmercury, Fish, *Pollutant identification, Ions, *Canada, *Japan, Ottawa River, Nagara River, Suimon River.

The concentrations of methylmercuric ion mercuric ion, and the total amount of mercury in three rivers are discussed: the Suimon and the Nagara Rivers in Japan and the Ottawa River in Canada. The Nagara River is very clean, but the Ottawa and Suimon Rivers have been polluted by industrial effluents containing mercury. During the past several years these two rivers have been cleaned up. Total mercury concentrations were 19.3 and 25.9 ng/liter in the Nagara and Suimon rivers respectively and 6.6 ng/liter in the Ottawa River. The average methylmercury concentration for the Ottawa River was 2.2 ng/liter, with the average proportion of methylmercury to the total amount of mercury being 33%, very similar to the results for the Nagara and Suimon Rivers. Sewage effluent from Ogaki City contained 39.6 ng/liter total mercury, and the proportion of methylmercury in the effluent (29%) was close to that of the river waters, 30%. These high proportions of methylmercury relative to total mercury may explain why fish in clean rivers and lakes in Northern Canada contain high concentrations of mercury, most of which is in the form of methylmercury. (Baker-FRC)
W82-06609

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,
Texas Univ. at Houston. School of Public Health.
R. K. Guthrie, E. M. Davis, D. S. Cherry, and J. R. Walton.
Water Resource Bulletin, Vol 18, No 1, p 135-138, February, 1982. 4 Tab, 21 Ref.

Descriptors: *Electric power production, *Coal, *Water pollution sources, Environmental effects, Water Quality, Water reuse, Wastewater management, Waste management.

The use of coal in the United States has increased much more rapidly than was predicted since 1972, with electric power generating plants accounting for much of the increased use. Solid wastes generated by coal combustion include bottom and fly ashes, which consist primarily of inorganic materials. The majority of chemical elements present in coal are concentrated in the fly ash. The sulfate content of the fly ash lowers the pH of water with which it comes in contact, affecting the chemical and physical state of other elements present in the fly ash. Detrimental effects of coal ash effluent runoff in the aquatic environment may result from suspended solids, sedimentation, accumulation of heavy metals in different trophic levels, passage of some of the metals through food chains, and changes in pH and chemical balance. Proper construction and operation of ash settling basins can, however, control the detrimental effects of these effluents and may even result in improvement of the water quality parameters of the effluent as compared with the source water. Special attention must be paid to the solubility or deposition in sediment of potentially toxic chemical elements from fly ash. This study suggests that the aquatic environment need not be adversely affected by solid waste materials from coal combustion and that the potential effects of reuse of effluent water from ash settling basins should be investigated. (Carroll-FRC)
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5G.
W82-06624

NONPOINT SOURCE LOADING RATES FROM SELECTED LAND USES,
Wisconsin Univ.-Madison. Dept. of Soil Science.
T. C. Daniel, R. C. Wendt, P. E. McGuire, and D. Stoffel.
Water Resources Bulletin, Vol 18, No 1, p 117-120, February, 1982. 2 Fig, 17 Ref.

Descriptors: *Nonpoint pollution sources, *Pollution load, *Land use, *Runoff volume, Phosphorus, Barn wastes, Dairy industry, Construction, Industrial wastewater, Water pollution sources.

Nonpoint source loading rates derived from monitoring natural runoff from selected land uses in a dairying watershed were compared in an effort to identify priority problems. Runoff volumes, sediment, and nutrient fractions from construction sites, barnyards, and dairying were monitored and expressed as areal loadings for comparison purposes. Sediment yield and total phosphorus loss was found to be directly proportional to runoff, with construction sites having the highest levels and general dairying the lowest. Runoff from barnyard areas had soluble phosphorus and ammonium nitrogen concentrations about 10 times higher than those of the other land uses investigated. Areal loss from nitrate nitrogen was highest from the construction site and was attributed to the higher volume of runoff per unit area. The results of this study show that barnyards in a dairying watershed contribute the highest areal loadings of sediment and nutrients, and especially of dissolved nutrients having the potential for such immediate adverse effects on water quality as rapid algae blooms and aquatic weed growth. Although the runoff and sediment yields were higher from the construction site, the dissolved phosphorus and ammonium nitrate loadings were low. Dairying activity showed the lowest sediment yield of the land uses investigate, reflecting the high amount of land area protected by cover crops. The particular effects of individual sites on water quality will also depend on proximity to surface water bodies and on other watershed characteristics affecting the delivery ratios of contaminants. (Carroll-FRC)
W82-06626

QUALITY OF STORMWATER RUNOFF FROM MOTORWAYS (DIEBESCHAFFENHEIT DER NIEDERSCHLAGSABFLUSSE VON AUTOBAHNEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergute- und Abfallwirtschaft.
H. Klein.
Wasserwirtschaft, Vol 72, No 2, p 37-43, February, 1982. 6 Fig, 6 Tab, 12 Ref. English Summary.

Descriptors: *Storm runoff, *Roads, *Pollutant identification, *Rainfall-runoff relationships, Precipitation, Pollutants, Heavy metals, Chlorides, Highways, Wastewater treatment, Drains, Storm drains, *West Germany, Runoff, Traffic, Water pollutant sources.

The quality of stormwater runoff from road surfaces was examined along three stretches of heavily-trafficked highway in West Germany. Routes A 81 and A 6 are flanked by high rims so that runoff is collected exclusively in storm drains, whereas Route A 8/B 10 has a grass verge over which runoff flows before entering a drain containing a sump. While median monthly rainfall was similar for all three roads, mean monthly runoff varied (599, 358, and 178 cu m/hectare for A 81, A 6, and A 8/B 10, respectively). This was attributed mainly to the difference in drainage systems. Annual mean concentration of chloride was 50-500 times greater in runoff than in rainwater collected at the same sites. Of all filterable material collected, only 4-7% originated in rain. Compared with discharge from a mechanical/biological sewage treatment plant, runoff contained significantly higher concentrations of most pollutants: a maximum of twice as much COD and cadmium, up to five times as much lead, copper, and zinc, up to 17 times as much filterable material, and 50-60 times as much polycyclic hydrocarbons. Smaller amounts of ammonium nitride and total phosphorus were present in runoff. Almost all runoff samples exceeded the maximal permissible limits for filterable material, iron, COD, mineral oil, and chloride. With the exception of chloride, pollutants were found in lesser amounts in runoff from Route A 8/B 10 than in that from the other two roads due to runoff permeating the grass verge. (Gish-FRC)
W82-06635

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),
Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
For primary bibliographic entry see Field 5E.
W82-06637

CADMIUM IN GAMMARIDAE (AMPHIPODA: CRUSTACEA) OF THE RIVERS WERRA AND WESER-II. SEASONAL VARIATION AND CORRELATION TO TEMPERATURE AND OTHER ENVIRONMENTAL VARIABLES,
Bremen Univ. (Germany, F.R.).
G-P. Zauke.
Water Research, Vol 16, No 6, p 785-792, June, 1982. 4 Tab, 59 Ref.

Descriptors: Rivers, *Cadmium, Crustaceans, *Gammarus, *Seasonal variations, Temperature effects, Metals, Fate of pollutants, Werra River, Weser River, *Federal Republic of Germany.

This study represents an attempt to realize the approach of a field study using multivariate statistical methods. The relationship between seasonal variation of cadmium in natural populations of Gammarus tigrinus and selected environmental variables was investigated. Results of a correlation analysis indicated that the observed variation of cadmium in G. tigrinus was related to the cadmium concentration of the river Weser and to the water temperature. However, partial correlation coefficient anlaysis showed water temperature to be the most important factor. The relationship between cadmium levels in G. tigrinus and in the water of the Weser turned out to be an imaginary correlation. Highest cadmium levels were noted in populations of G. tigrinus collected in winter, lowest in populations collected in summer. These findings are discussed in view of the hypothesis of an increased elimination of cadmium via exuvia in the summer population. (Baker-FRC)
W82-06659

AREAL EXTENT OF A PLUME OF MINERALIZED WATER FROM A FLOWING ARTESIAN WELL IN DADE COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199852, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-20, 1982. 20 p, 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Water quality, *Groundwater, *Path of pollutants, *Saline water intrusion, Aquifers, Specific conductivity, Chlorides, Water pollution, *Florida, Dade county, Everglades, Floridan aquifer, Biscayne aquifer.

A flowing artesian well that taps the Floridan aquifer at Chekika Hammock State Park is contaminating the overlying Biscayne aquifer with saline water. The plume of mineralized water extends approximately 7 miles southeast of the well and ranges in width from 1 to 2 miles. The areal extent of contamination in the primary plume is approximately 12 square miles. The principal ions contaminating the Biscayne aquifer are chloride, sodium, and sulfate. (USGS)
W82-06680

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. R. Seitz, and M. L. Jones.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-102, October 1981. 56 p, 9 Fig, 10 Tab, 18 Ref.

Descriptors: *Water quality, *Streamflow, *Path of pollutants, *Data collections, Outlet channels, Cross sections, Discharge measurement, Velocity, Water analysis, Nutrients, Bacteria, Trace metals, *Idaho, Spokane River, Coeur d'Alene Lake, Post Falls Dam.

The Spokane River leaves the northern end of Coeur d'Alene Lake, flows westward past the cities of Coeur d'Alene and Post Falls, Idaho, through the Spokane Valley, and joins the Columbia River west of Spokane, Wash. Cross-sectional properties and water-quality characteristics were determined for flows of 6,100 to 8,440 cubic feet per second during June 8 to 12; 750 to 1,760 cubic feet per second during August 24 to 27; and 1,790 to 1,630 cubic feet per second during November 3 to 7, 1980. Cross-sectional areas measured ranged from 4,620 square feet to 17,000 square feet. Flow velocities ranged from 2.00 feet per second during June to less than 0.10 foot per second during August and November. Water quality in the reach was generally good. A small increase of total ammonia nitrogen occurred downstream of the Coeur d'Alene sewage-treatment plant. (USGS)
W82-06681

EVALUATION OF A PREDICTIVE GROUND-WATER SOLUTE-TRANSPORT MODEL AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
B. D. Lewis, and F. J. Goldstein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204066, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-25, March 1982. 71 p, 26 Fig, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Groundwater, *Radioactive waste disposal, *Path of pollutants, Computer models, Solute transport, Chemical wastes, Chlorides, Tritium, Geohydrology, Observation wells, Monitoring, Groundwater movement, Chemical analysis, *Idaho, Idaho National Engineering Laboratory, Snake River Plain aquifer.

Aqueous chemical and radioactive wastes discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 have affected the quality of the ground water in the underlying Snake River Plain aquifer. The aqueous wastes have created large and laterally dispersed concentration plumes within the aquifer. The waste plumes with the largest areal distribution are those of chloride, tritium, and with high specific conductance values. The data from eight wells drilled near the southern INEL boundary during the summer of 1980 were used to evaluate the accuracy of a predictive modeling study completed in 1973, and to simulate 1980 positions of chloride and tritium plumes. Data interpretation from the drilling program indicates that the hydrogeologic characteristics of the subsurface rocks have marked effects on the regional ground-water flow regimen and, therefore, the movement of aqueous wastes. As expected, the waste plumes projected by the computer model for 1980, extended somewhat further downgradient than indicated by well data due to conservative worst-case assumptions in the model input and inacurate approximations of subsequent waste discharge and aquifer recharge conditions. (USGS)
W82-06689

HYDROLOGIC AND CHEMICAL EVALUATION OF THE GROUND-WATER RESOURCES OF NORTHWEST ELKHART COUNTY, INDIANA,
Geological survey, Indianapolis, IN. Water Resources Div.
T. E. Imbrigiotta, and A. Martin, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197369, Price codes A08 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 81-53, October 1981. 140 p, 49 Fig, 14 Tab, 42 Ref.

Descriptors: *Groundwater, *Groundwater availability, *Water quality, *Water pollution effects, Landfills, Leachate, Observation wells, Aquifer characteristics, Flow system, Glacial drift, Organic compounds, Plumes, Groundwater movement, Water level fluctuation, Drawdown, Computer models, Chemical analysis, *Indiana, Elkhart County.

A study of the aquifer system underlying northwest Elkhart County, Indiana, has defined the general flow and quality of the area's ground water. The regional ground-water flow is toward the St. Joseph River. A ground-water-flow model was used to simulate pumpings of 7.5-, 10-, and 20-million gallons per day at the airport. The model-generated water-level maps indicated that only for the 20-million-gallons-per-day simulated pumping could a small part of the total flow into the pumping center come from the Himco landfill area. The general ground-water quality was characterized by slightly basic pH (7-8), average hardness greater than 150 milligrams per liter as calcium carbonate, and a calcium bicarbonate water type. Eight volatile organic compounds were detected in samples from an industrial park area in east Elkhart. Concentrations of dissolved solids, bicarbonate, bromide, chloride, sulfate, ammonia, calcium, magnesium, manganese, potassium, sodium, and dissolved organic in the leachate were at least five times their background concentration. The leachate plume was primarily in the shallow aquifer and extended between 3,100 and 5,600 feet downgradient from the Himco landfill. (USGS)
W82-06691

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,
Missouri Univ., Kansas City. Dept. of Biology.
D. H. Stern, and M. S. Stern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256769, Price codes: A06 in paper copy, A01 microfiche. Report, May 1982, Water Resources Research Center, Columbia, MO. 106 p, 5 fig, 1 Tab, 42 Ref, 2 Append. OWRT A-128-MO(1), 14-34-0001-1127.

Descriptors: *Water pollution sources, *Heavy metals, *Pollution load, *Sediments, *Bottom sampling, Environmental protection, Nonpoint pollution sources, Population exposure, Sublethal effects, Cobalt, Cadmium, Chromium, Copper, Iron, Rural areas, Streams, Urban areas, Sampling, Surface runoff, Rivers, Trace metals, *Missouri, Kansas City.

The concentration and distribution of sediment heavy metals were determined in the major stream of each of 3 adjacent watersheds in the Kansas City (Missouri) metropolitan area. The metals were examined in bottom sediments of each stream during 4 seasons under various precipitation/flow conditions. The effects of human activities/urbanization on sediment metal levels/distribution in the streams was assessed. Kansas City area sediments contained higher levels of many metals than sediments of other watercourses. Downstream Blue River stations indicated urban industrial pollution (e.g., runoff from highly active roads, rail lines, bankside steel fabricators, automobile salvage yards). Blue River concentrations of a number of metals (cadmium, chromium, copper, iron, lead, manganese, nickel, zinc) downstream, exceeded those at residential/park/ pastoral upstream locations and those in the other two (suburban and rural) streams studied. Only cobalt was higher in rural areas than urban areas. Stations near the confluence of each stream with the Missouri River had metal concentrations exceeding literature data for many of the metals analyzed. Iron levels appeared slightly higher in January than at other times of the year; other metals showed no seasonable variation. Water quality data at the sediment sampling stations are also reported. (Zielinski-MAXIMA)
W82-06702

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,
Massachusetts Univ., Boston. Dept. of Biology.
M. P. Shiaris, and G. S. Sayler.
Environmental Science and Technology, Vol 16, No 6, p 367-369, June 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Polychlorinated biphenyls, *Biotransformation, *Microbial degradation, Reservoirs, Water sampling, Oxidation, Chlorine, Biodegradation, Path of pollutants, Water pollution, Biological oxidation, Mineralization, *Tennessee, Center Hill Reservoir.

The ability of natural mixed microbial populations in lake water to oxidize PCBs was investigated. A preliminary examination of PCB removal (by hexane extraction) in samples of water from Center Hill Reservoir, Tennessee, that had been exposed to PCBs indicated a significant reaction of PCBs with microbial populations but did not assess the fate of PCBs. Incubation of water samples from the reservoir with a PCB mixture containing 54% chlorine by weight resulted in no oxidation. This indicates that for complex mixtures of PCB, mineralization was insignificant relative to adsorption, volatilization, and cellular accumulation, which occur kinetically at a much faster rate. However, incubation of samples with 2-chlorobenzoic acid and chlorobenzoylformic acid (chlorophenylglyoxylic acid). The results indicate that chlorobenzoic acids can be expected to accumulate during degradation of the lesser chlorinated biphenyls in the environment and support the hypothesis that aquatic ecosystems have detectable potential for PCB biodegradation. (Gish-FRC)
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
J. I. Parker, and J. G. Ferrante.
Environmental Science and Technology, Vol 16, No 6, p 363-367, June 1982. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Offshore platforms, *Natural gas, *Discharge measurement, *Organic compounds, *Inorganic compounds, Plumes, Pollutant identification, Sodium, Magnesium, Sulfate, Chloride, Hydrocarbons, Volatile hydrocarbons, Methane, Ethane, Nephelometry, Lakes, *Lake Erie,

Canada, Environmental Effects, Water pollution sources.

Turbid discharge plumes from a Canadian offshore natural gas drilling rig in Lake Erie were mapped by continuous-flow nephelometry, and the concentrations of certain organic and inorganic constituents in the plumes were measured. Buoyant surface plumes A and B were tracked and mapped on 5.30.1979, while plume C was monitored on 5.31.1979. Plumes A and B drifted eastward about 600-1,500 m before dispersing to background total suspended solids (TSS) levels (< or = 0.4 mg/L). They achieved maximum widths of about 200 m and included areas of approximately 10-25 ha. TSS concentrations ranged from 0.4 to 1.2 mg/L. Plume C covered about 3.5 ha and drifted only about 320 m before TSS concentrations declined to background level. However, TSS levels were higher in plume C, reaching a maximum of 5.3 mg/L about 25 m downcurrent of rig discharge. The survey of plume chemistry showed that sodium, sulfate, and chloride concentrations were not elevated in plume C at distance > 25 m and that these constituents dispersed rapidly after discharge. At a distance of 25 m from the rig, magnesium concentrations were significantly higher than at other locations within the plume and at reference stations, but rapidly declined to ambient lakewater levels throughout the remainder of the plume, suggesting that the area of high concentration was < 1 ha. Volatile hydrocarbon analysis showed minor increases of methane and ethane (less than a factor of 2 above ambient levels) in plume C, and these declined rapidly at distances > 100 m from the rig. Absolute levels were < 25 micrograms/L. The potential for adverse environmental effects resulting from these discharges is considered minimal. (Gish-FRC)
W82-06720

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,
Military Engineering Services, Hyderabad (India).
For primary bibliographic entry see Field 5C.
W82-06723

PHYSICOCHEMICAL PROPERTIES AS USEFUL TOOLS FOR PREDICTING THE ENVIRONMENTAL FATE OF ORGANIC CHEMICALS,
Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
W. Klopffer, G. Rippen, and R. Frische.
Ecotoxicology and Environmental Safety, Vol 6, No 3, p 294-301, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Organic compounds, *Environmental effects, Physicochemical properties, Persistence, Sinks, Vapor pressure, Volatility, Solubility, Adsorption, Path of pollutants, *Fate of pollutants, Chemicals, Organic wastes,.

The physical and chemical properties of a chemical largely determine the distribution of that chemical between the environmental media of air, water and soil/sediment. Relatively inexpensive measurements can be used to predict roughly the distribution of these chemicals. In particular such estimates are very important in the assessment of new chemicals. In the case of new chemicals, nothing is known about the behavior of the substance in the natural environment. Models still remain to be developed for calculating the distribution on the basis of physicochemical data for different environmental conditions or, alternatively, by using globally averaged data. It is shown that, except in the case of highly persistent chemicals, distribution can only be considered in conjunction with (biotic and abiotic) degradation processes. According to the knowledge at present, the key properties with regard to the environmental fate included vapor pressure, water solubility, absorption and desorption behavior, partition coefficient (octanol/water), volatility from aqueous solution, and hydrolysis and photochemical reactivity in the air, water, and when absorbed at surfaces (aerosol, soil, organic matter). An interesting consequence of the close interrelation of persistence and mobility is that if a chemical has a strong tendency to enter a specific medium or sector of the environment such as water and there is no sink for it in this sector but only in another sector, such as in the air, then the transfer velocity between these sectors will determine the persistence. Thus in certain cases mobility may control persistence. (Baker-FRC)
W82-06727

PRELIMINARY STUDY OF THESSALONIKI BAY FOR CONTAMINATION BY MERCURY AND LEAD,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
G. S. Vasilikiotis, N. A. Voulouvoutis, D. G. Themelis, and M. C. Sofoniou.
Chemosphere, Vol 11, No 5, p 479-496, May, 1982. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Heavy metals, *Wastewater disposal, Thessaloniki Bay, *Greece, *Mercury, *Lead, Industrial wastes, Municipal sewage, Water pollution sources, Path of pollutants.

Thermaikos Gulf is estimated to receive more than 80,000 cubic meters per day of domestic sewage and some 25,000 cubic meters per day of industrial wastewater. Mercury and lead concentrations were examined in the Gulf as possible indicators of pollution levels. The northern part of the Gulf was selected for study due to its geological configuration and the fact that the municipal sewage and factory wastes enter this particular basin directly. The amounts of mercury and lead in the sea water and sediment samples taken from this basin were significantly increased in regions close to the outfalls of sewage and wastewater. Contamination peaks were seasonally correlated with various maintenance programs carried out in the industrial plants. At these times the industrial wastewaters even more heavily contaminated with the heavy metals. The high metal content of the seawater at the start of the winter season could also be due to the rainfall washing out to sea the street dust which is rich in heavy metal dust particles. At this same time the increased wind and wave activity in the water body would be stirring up metal particles which had settled to the bottom sediment layer. Analysis showed that the heavy metal concentration in the sediment layer was related to the sediment content of organic residues. (Baker-FRC)
W82-06728

RATES OF MINERALIZATION OF TRACE CONCENTRATIONS OF AROMATIC COMPOUNDS IN LAKE WATER AND SEWAGE SAMPLES,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. E. Rubin, R. V. Subba-Rao, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1133-1138, May, 1982. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Lakes, *Mineralization, Wastewater, Metabolism, Microorganisms, Organic compounds, Aromatic compounds, Phenols, Microbiological studies, Kinetics Eutrophication, Oligotrophic lakes, *New York.

This investigation was designed to determine the kinetics of mineralization of several compounds in samples of freshwater and sewage. For this purpose a method was developed to test the rates at chemical concentrations lower than those studied heretofore. The rates of mineralization of phenol, benzoate, benzylamine, p-nitrophenol, and di(2-ethylhexyl) phthalate added to lake water at concentrations ranging from a few picograms to nanograms per milliliter were directly proportional to chemical concentration. At levels of less than 1 pg of phenol or p-nitrophenol per ml the rates were still linear, but they were below the predicted value at 1.53 pg of 2,4-dichlorophenoxyacetate per ml. Mineralization of 2,4-dichlorophenoxyacetate was not detected in samples of lake water containing 200 ng of the chemical per ml. The slope of a plot of the rate of phenol mineralization in samples of three lakes as a function of its initial concentration was lower at levels of 1 to 100 micrograms/ml than at higher concentrations. In lake water and sewage supplemented with less than 60 ng ogf C14-labeled benzoate or phenylacetate per ml, 95 to 99% of the raioactivity disappeared from solution, indicating that the microflora assimilated little or none of the carbon. The extent of mineralization of some compounds in samples of two lakes and sewage was least in the water with the lowest nutrient levels. No mineralization of 2,4-dichlorophenoxyacetate and the phthalate ester was observed in samples from an oligotrophic lake. These data suggest that mineralization of some chemicals at concentrations of less that 1 microgram per ml is the result of activities of organisms that metabolize the chemicals at low concentrations but assimilate little or none of the substrate carbon. (Baker-FRC)
W82-06738

SURVIVAL OF ESCHERICHIA COLI IN LAKE BOTTOM SEDIMENT,
Wisconsin Univ. La Crosse, River Studies Center.
P. LaLiberte, and D. J. Grimes.
Applied and Environmental Microbiology, Vol 43, No 3, p 623-628, March, 1982. 2 Fig, 2 Tab, 39 Ref.

Descriptors: *Lake sediments, *Bacteria, Lakes, *Bottom sediment, Sediment, Sedimentation, Escherichia Coli, Fecal Coliforms, Coliforms, Lake Onalaska, Mississippi River, Water quality, Culturing techniques, Dialysis cultures, *Minnesota.

The in situ survival of the fecal coliform Escherichia coli in lake bottom sediment was investigated using dialysis culture techniques. The study sites were located in Lake Onalaska, an impoundment of lock and dam no. 7 on the Mississippi River at Dresback, Minnesota. The lake surface area was 2,146 hectares, with an average depth of 155 cm. The pool receives water from the Mississippi and Black Rivers and has water chemistry characteristics similar to those of the Mississippi. Lake Onalaska does not stratify, has an average annual alkalinity of 125 mg/liter, supports extensive growths of rooted, aquatic vegetation, has a high nutrient trapping efficiency, and is quickly progressing toward hypereutrophic conditions. Daily most probable number determinations indicated that E. Coli populations in unsterile inoculated sediment fluctuated between 530 and 2200 bacteria per g of silty clay and between 3000 and 14000 bacteria per g of sand. Autoclaved silty clay sediment inoculated with 1,000,000 bacteria per g showed increases to 220,000,000 bacteria per g in 3 days. During the same period, autoclaved sand sediment inoculated with 120,000 cells per g increased to 54,000,000 bacteria per g. By day 5, populations in both cultures had decreased by 1 log. The ability of E. coli to survive for several days in aquatic sediment in situ suggests that fecal coliforms in water may not always indicate recent fecal contamination of that water, but rather resuspension of viable sediment-bound bacteria. (Baker-FRC)
W82-06741

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,
Cawthron Inst., Nelson (New Zealand).
For primary bibliographic entry see Field 5A.
W82-06755

KINETICS AND EXTENT OF MINERALIZATION OF ORGANIC CHEMICALS AT TRACE LEVELS IN FRESHWATER AND SEWAGE,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
R. V. Subba-Rao, H. E. Rubin, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1139-1150, May, 1982. 5 Fig, 8 Tab, 15 Ref.

Descriptors: *Mineralization, *Organic compounds, *Kinetics, Metabolism, Microorganisms, Lakes, Eutrophication, Oligotrophic lakes, Natural waters, Wastewater.

The mineralization of low levels of several C14-labeled organic compounds was studied in natural waters. Attempts were also made to enhance microbial activity by supplementing the waters with

readily available carbon and energy sources. Lake waters with different natural nutrient levels wre used to assess the effect of nutrient status on the extent of mineralization. A sensitive and rapid method to detect mineralization was developed. From 93 to 98% of benzoate, benzylamine, aniline, phenol and 2,4-dichlorophenoxyacetate at one or more concentrations below 300 ng/ml was mineralized in samples of lake waters and sewage, indicating little or no incorporation of carbon into microbial cells. Assimilation of C-14 by the cells mineralizing benzylamine in lake water was not detected. Mineralization in lake waters was linear with time for aniline at 5.7 pg to 500 ng/ml, benzylamine at 310 ng/ml, phenol at 102 fig to 10 mg/ml, 2,4-dichlorophenoxyacetate at 1.5 pg/ml, and di(2-ethylhexyl)phthalate at 21 pg to 200 ng/ml, but it was exponential at several p-nitrophenol concentrations. The rate of mineralization of 50 and 500 ng of aniline per ml and 200 pg and 2.0 ng of the phthalate per ml increased with time in lake waters. The phthalate and 2,4-dichlorophenoxyacetate were mineralized in samples from a eutrophic but not an oligotrophic lake. Results obtained on addition of benzoate-utilizing bacteria, glucose or phenol to the lake water showed that the kinetics of mineralization, the capacity of the aquatic community to assimilate carbon from the substrate or the extent of assimilation, and the sensitivity of the mineralizating populations to organic compounds are different at trace levels than at higher concentrations of organic compounds. (Baker-FRC)
W82-06756

MODEL ECOSYSTEM FOR ENVIRONMENTAL TRANSPORT OF XENOBIOTICS,
Jyvaskyla Univ. (Finland). Dept. of Cell Biology.
M. T. Virtanen, M. Kihlstrom, A. Roos, and H. Kainulainen.
Archives of Environmental Contamination and Toxicology, Vol 11, No 4, p 419-424, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Xenobiotics, *Environmental effects, *Pesticides, Soil contamination, Model studies, Ecosystems, DDT, Ecology, Soil properties, Organic compounds, Agricultural chemicals, Soil solution, Leaching, *Path of pollutants, Laboratory studies.

A compartmentalized model is reported to study the transport of agricultural chemicals in soil drainage. In this model drainage from the soil is channeled into the aquatic system together with groundwater, providing a slow, fluctuating water flow. C-14 labeled DDT was used as a reference toxicant. The variability of the model exosystem was evaluated, and some recommendations are given for future work. The terrestrial part was built of washed gravel and soil in a container. The aquatic part was an aquarium provided with an overflow pipe. A layer of gravel was scattered on the bottom of the aquarium. The behavior of DDT in this system may be considered to mimic its behavior in a soil/water system under natural conditions. DDT became tightly bound to the soil, which acted as a reservoir. A compound with a high partition coefficient (highly lipophilic) such as DDT has a strong tendency to accumulate in aquatic biota, but its transfer to the aquatic environment is limited by its adsorptive properties, and its availability to aquatic biota is accordingly reduced. (Baker-FRC)
W82-06760

DIFFERENTIAL PHOSPHORUS ASSIMILATION IN ATTACHED VS. UNATTACHED MICROORGANISMS,
North Carolina Univ., Morehead City. Inst. of Marine Sciences.
H. W. Paerl, and S. M. Merkel.
Archiv fur Hydrobiologie, Vol 93, No 2, p 125-134, January, 1982. 3 Tab, 21 Ref.

Descriptors: *Microorganisms, *Phosphorus, *Absorption, *Path of pollutants, Estuaries, Estuarine environment, Lakes, Eutrophication, Metabolism, Nutrients, Bacteria, Natural waters, Suspended sediments, Oligotrophic lakes, Trophic levels, Particulate matter, *Waste assimilative capacity.

One aspect of particle-related phosphorus uptake was investigated - differential uptake activities of attached vs. free floating bacteria in natural aquatic ecosystems. This is significant in determining the relative importance of phosphorus uptake and cycling on particle-bound vs. free-floating microorganisms. Microautoradiography was used to study the uptake of phosphorus. A variety of aquatic ecosystems was studied, exhibiting a range of trophic states. Lake Tahoe, California, a deep ultra-oligotrophic lake, was studied, as was Heart Lake, Ontario, which is a small, shallow, eutrophic lake, and Lake Taupo on the North Island of New Zealand, which is a deep oligo-mesotrophic lake. Samples were also taken from the Newport River Estuary in North Carolina. In all systems studied particle-rich waters showed higher uptake rates per unit volume than particle-poor waters. Bacteria associated with particles were responsible for elevated uptake rates and exhibited higher relative uptake rates per cell than free-living bacteria. Differences in cellular phosphorus uptake between attached and unattached bacteria were greatest under oligotrophic and least under eutrophic conditions. The significance of these findings with regard to particles as nutrient-concentrating microenvironments in natural waters is discussed. (Baker-FRC)
W82-06762

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,
Institute fuer Meeresforschung (Germany, D.R.).
S. Wellershaus.
Archiv fur Hydrobiologie, Vol 92, No 2, p 161-198, September, 1981. 21 Fig, 1 Tab, 66 Ref.

Descriptors: *Estuarine environment, *Turbidity, Estuaries, Marine environment, Coastal waters, Mud flats, Sedimentation, *Suspended sediments, Tidal waves, Tidal marshes, Tidal effects, Water currents, Weser Estuary, *West Germany.

The accumulation of particles with low settling velocities along a mud shoal is shown to be due to a combination of transport of particles from other areas, formation of particles in the salt wedge area, and trapping of particles due to hydrographic mechanisms. The tidal Weser Estuary was the study site; it experienced a turbidity maximum and mud shoal near the tip of the salt wedge. Non-tidal estuaries may have a mud shoal, but since alteration and strength of tidal currents are lacking, a strong turbidity maximum may also be absent. In all undisturbed tidal coastal plain estuaries the same mechanisms may lead to effects similar to those in the Weser. However, the channel will be much shallower, and in the turbidity maximum the seston concentration may be less. It is noted that fractionation of particles into subclasses may also lead to fraction of pollutants that may be constituents of particles in one of these fractions. It is expected that dredging will initiate chemical and biological reactions that would not occur in an undisturbed estuary. Thus some types of suction dredging select the heavier particles such as fine sand and larger pieces, while the lighter aggregates escape out of the hold together with the overflowing water and remain in the turbidity maximum. Thus natural processes are hindered by maintenance dredging. The main cause for the muddy character of the sediment is the non-tidal estuarine circulation, which results in collection, amassment and settling of particles with low settling velocities in the salt wedge area. Tidal oscillation, causing alternating sedimentation and resuspension of the particles, is the main source of visual turbidity in an estuary not disturbed by man. (Baker-FRC)
W82-06766

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert.
Water Research , Vol 16, No 6, p 775-784, June, 1982. 3 Fig, 3 Tab, 37 Ref.

Descriptors: *Heavy metals, *Public health, Mercury, Lead, Copper, Chromium, Cadmium, Chao Phraya River, *Thailand, Estuaries, Seasonal variations, bottom sediments, Fish.

Heavy metal pollution was examined in the Chao Phraya River estuary. Seasonal variations were noted, but the patterns were not the same for different heavy metals of different sampling stations along the river. The relatively high concentrations of heavy metal in the river mouth vicinity indicated a possible accumulation of heavy metals which may have been due to the movement of pollutants from upstream, sources from wastewater discharges from the Bangkok Metropolis and industrial estates south of Bangkok, and the physical characteristics of the estuary and tidal movements that tended to stagnate water in this area. Twenty-seven species of fish of various sizes were also studied. The results indicate that the Chao Phraya River estuary is being polluted by heavy metals, and that the accumulation of Cd, Cu, Cr, and Pb in water in the vicinity of the river mouth is significant. If pollution were to continue, long term accumulation of heavy metals in sediments and fish in the river mouth could occur because the water pH in this area is between 7 and 8 and because the bio-accumulation and bio-magnification of fish reared in heavy metal polluted water have been reported elsewhere. The probable ingestion of mercury and lead in fish from this region is a matter for concern. (Baker-FRC)
W82-06774

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W82-06787

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and A. L. Yarechewski.
Journal of Emvironmental Science and Health, Part B, Vol 17, No 4, p 363-380, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Agricultural chemicals, *Degradation, *Fate of pollutants, Laboratory studies, Degradation products, *Terbutryn, *Herbicides, Water pollution, Organic compounds, Environmental effects, *Oxidation-reduction potential, *Sediments, Rivers, Ponds, Bottom sediments.

The major degradation pathways of terbutryn in sediment and water were studied under laboratory conditions which simulated the use of this herbicide in aquatic environments. Degradation of terbutryn in static culture flask incubations proceeded slowly, with half-lives of about 380 days in both river and pond sediments. The disappearance of terbutryn in water was more rapid , with half-lives of 240 days and 180 days in water above pond and river sediments, respectively. Redox potentials in these static systems following 200 days of incubation averaged +384 mv in water and +364 mv in sediment, indicating that aerobic conditions prevailed. Degradation proceeded much more slowly in autoclaved sediments and water, suggesting that biological activity was essential in order for rapid degradation to occur. The major degradation product from static incubations was hydroxyterbutryn (HT). Also eluting on the chromatogram was a peak corresponding to N-deethyl hydroxy terbutryn (DEHT) as a minor product. A second major product was terbutryn sulfoxide (TS). A comparison of these studies with field studies on the fate of terbutryn in small ponds indicated that the laboratory studies closely simulated the persistence of the herbicide. Breakdown of terbutryn in laboratory sediment-water systems appears to be inversely related to redox potential, as the degradation rate was slowed dramatically at low potential. Measurement of redox potential in sediments from treated water bodies in field experiments may be a useful means of predicting terbutryn persistence under field conditions. (Baker-FRC)
W82-06790

COAL AND COAL MINE DRAINAGE,

Tennessee Valley Authority, Chattanooga.
H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 717-723, June, 1982. 2 Tab, 67 Ref.

Descriptors: *Literature review, *Coal mining, *Mine drainage, *Mine wastes, *Reviews, Water pollution sources, Fate of pollutants, Strip mines, Coal mines, Acid mine drainage, Water pollution effects, Regulation, Water pollution control, Wastewater treatment, Leachates, Slurries, Sulfur, Sulfates, Wastewater treatment.

The role of coal and mine drainage in water pollution is the subject of a literature review. A table presents the subjects and authors of selected papers from the 1981 symposium on surface mining hydrology, sedimentology, and reclamation. Studies on formation of coal mine drainage included identifying potential acid-prod cing strata, the good correlation between carbonate-sulfur ratio and effluent quality, and pyrite oxidation. The effects of coal mining on hydrology and stream water quality are reported from various locations in the U.S. Acid mine drainage and groundwater deterioration were reported in many cases. In the western U.S., total dissolved solids is the major problem associated with coal mining. Methods for treating mine drainage include chemical neutralization, settling ponds, and limed plots of land. Reclamation techniques involve acid-tolerant macrophytes in streams and lakes and use of municipal sludge in revegetation. The impact of coal cleaning was evaluated in 17 projects sponsored by the EPA. Generally, physical coal cleaning is more economical than other sulfur-removal strategies such as flue gas desulfurization and use of low-sulfur coal. Problems with coal transportation are mentioned: formation of carcinogens in chlorinated coal-slurry pipeline water and corrosion on combustion of coal slurried with salt water. Some work has been done on the subject of coal pile drainage. (Cassar-FRC)
W82-06802

GROUND WATER,
SMC-Martin, King of Prussia, PA.
G. H. Emrich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 784-786, June, 1982. 29 Ref.

Descriptors: *Literature reviews, *Groundwater, *Reviews, Sampling, Sample preparation, Water sampling, Model studies, Monitoring, Water quality, Organic compounds, Mathematical models, Groundwater pollution, Path of pollutants.

Recent research in the area of groundwater pollution is cited in this review of the current literature. The main emphasis during 1981 has been the need for determining the occurrences, extent, and sampling of groundwater pollution in response to the implementation of federal and state programs. A manual of groundwater sampling procedures was prepared. A grab sampler for obtaining highly volatile organic compounds from unsaturated zones was presented. Several researchers indicated a need for improving the quality of information obtained from groundwater sampling programs. Implementation of the underground injection control phase of the State Safe Drinking Water Act of 1974 began in earnest. A digital model of a buried channel aquifer contaminated by hydrocarbons was used to evaluate three management alternatives. Laboratory-determined chemical parameter values were used in simulation of transport of ion-exchanging solutes governed by local chemical equilibrium. A kinematics mathematical model was used to develop flow and arrival time plots of groundwater contaminants. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, recognizing the need for a systematic approach to setting priorities for the investigation and cleanup of hazardous waste sites. Two roles that surface geophysical methods can play in groundwater monitoring were defined - direct measurement of contaminated water and the determination of boundary conditions. A method was presented for calculating apparent resistivities for application in delineating plumes of contaminated ground water. Surface resistivity was used in a monitoring program. A combination of four surface geophysical methods was used to investigate groundwater pollution and locate buried drums at a chemical dump. (Baker-FRC)
W82-06807

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto.
Water Research, Vol 16, No 6, p 1065-1070, June, 1982. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Phosphorus, *Kinetics, Path of pollutants, Measuring instruments, Chemical reactions, Particulate matter, Water pollution control, Suspended solids, Water analysis.

The design, testing and application of an experimental apparatus which has proved useful to the kinetic description of two aspects of phosphorus dynamics in aquatic systems are described. The apparatus is referred to as a Dual Culture Diffusion Apparatus (DCDA), and it is designed so that two microbial populations can interact in a syntrophic manner through substances dissolved in the liquid phase. The apparatus permits the extraction of process kinetic data for several types of particulate-water interactions. The apparatus is useful and flexible for characterizing and quantifying certain biochemical processes in aquatic systems. It may also be used for adsorption-desorption process studies as a function of time without disturbing the vessel housing the process of interest. Other applications include microbial mediated recycle or transformation of organics bound to particles, biological partitioning and microbial degradation or release of the partitioned compounds, and many types of microbial species interactions. (Baker-FRC)
W82-06829

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, J. Schreiner, and G. D. Hopkins.
Water Research, Vol 16, No 6, p 1025-1035, June, 1982. 13 Fig, 8 Tab, 13 Ref.

Descriptors: *Groundwater recharge, *Water quality, Aquifers, Recharge, *Artificial recharge, Injection, Replenishment, Water supply development, Water supply, *California, Palo Alto Baylands, *Organic compounds, Biodegradation.

A field study was performed wherein reclaimed water was injected directly into an aquifer in the Palo Alto Baylands, near San Francisco Bay. The injection rate was 6 liters/second of reclaimed municipal wastewater. The concentrations of organic constituents were affected by processes such as adsorption and biodegradation during recharge even though the recharged water had received advanced treatment including granular activated carbon. The influence of adsorption was observed as retardation of the transport of trace organic compounds, which are retained to varying degrees in the aquifer. The effects of biodegradation are evidenced by decreasing concentrations of total organic carbon, chemical oxygen demand, and dissolved oxygen as the water spread out from the injection point. In general the concentrations of TOC and COD responded rapidly to fluctuations in input concentration, indicating that the bulk of organic constituents in the reclaimed water did not engage in sorptive interaction with the aquifer material. Halogenated organic compounds showed no evidence of retardation or retention during aquifer passage. Organic pollutants remaining after water reclamation treatment pose a potential health threat if the reclaimed water is to be directed to potable reuse. Groundwater recharge by direct injection affords protection by affording opportunities for adsorption and degradation and by smoothing concentration fluctuations. (Baker-FRC)
W82-06831

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,
State Univ. of New York, Syracuse. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W82-06836

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,
Plainville Water Co., CT.
For primary bibliographic entry see Field 5G.
W82-06842

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W82-06860

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06861

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2F.
W82-06864

A CASE STUDY OF A CHEMICAL SOIL: POLYCHLORINATED BIPHENYLS (PCBS) 1. HISTORY, DISTRIBUTION, AND SURFACE TRANSLOCATION,
National Research Council of Canada, Ottawa (Ontario).
J. R. Roberts, J. A. Cherry, and F. W. Schwartz.
Water Resources Research, Vol 18, No 3, p 525-534, June, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Translocation, Water pollution sources, Organic chemicals, Industrial wastes, Leaching, Permeability, Soil porosity, *Saskatchewan,.

This paper presents background information about the spill, explains techniques used in sample collection, preparation and analysis, and describes the distribution and surface movement of PCBs at the spill site, a transformer manufacturing plant in Regina, Saskatcheqan, Canada. Between 6,800 and 21,000 liters of transformer oil containing Aroclor 1254 and chlorobenzenes were spilled at an underground pipe break. Large quatities of PCBs were found to have migrated both vertically and horizontally at the site. PCBs at concentrations of about 1000 mg/kg moved downward through granular fill and 9 meters of fractured Regina clay. Contaminant migration along the interface of the clay and the upper unit of permeable granular fill probably accounted for the extensive lateral movement. It was argued that because of the low organic content of the geological units at the site and the hydrophobicity of chlorinated organics like PCBs, contaminants at many locations exist in three phases: a dissolved aqueous phase, an adsorbed phase, and an oily liquid phase. Movement of the oily liquid seems to be the most likely explanation for the migration of large quantities of PCBs downward through fractures in the clay and laterally through the granular fill. (Baker-FRC)
W82-06865

A CASE STUDY OF A CHEMICAL SPILL: POLYCHLORINATED BIPHENYLS (PCBS). 2. HYDROGEOLOGICAL CONDITIONS AND CONTAMINANT MIGRATION,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, J. A. Cherry, and J. R. Roberts.
Water Resources Research, Vol 18, No 3, p 535-545, June, 1982. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Polychlorinated biphenyls, Water pollution sources, Organic chemicals, Leaching, Permeability, Soil porosity, Aquifers, Drinking water, Wells, Well water, Geology.

The hydrogeology of a spill site in Regina, Canada is described as it relates to the observed patterns of PCB contamination. Six major hydrostratigraphic units were identified from detailed test drilling and sampling. From the surface downward there are a thin surface fill, Regina clay, Condie silt, till zone, interglacial silt, and Regina aquifer system. This later unit is a significant source of potable groundwater. At present the nearest wells are hundreds of meters from the spill site. The permanent water table is situated below the Condie silt in sandy glacial till. An active perched groundwater system was developed within the thin fill layer beneath the floor of the plant. The extensive lateral flow of groundwater in this zone has contributed significantly to the spreading of PCBs at this site. The PCBs have also moved downward through fractures in the Regina clay and upper part of the Condie silt. It can be expected that capillary forces will halt the downward movement as fractures narrow or stop. However, the possible existence of fractures connecting the contaminated zone to the Regina aquifer system or the potential for transport as a dissolved phase in the groundwaters may permit PCBs to migrate downward to the aquifer or to flow laterally off-site. The most significant hazard is the potential for contamination of future water supply wells that may be placed near the site or aquifer contamination that could result if future drilling provides pathways for contaminants through poorly sealed wells or test holes. (Baker-FRC)
W82-06866

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,
Minnesota Pollution Control Agency, Roseville.
S. Y. T. Leung, and J. J. Richard.
Water Resources Bulletin, Vol 18, No 3, p 485-493, June, 1982. 2 Fig, 4 Tab, 54 Ref.

Descriptors: *Pesticide residues, *Pesticide, *Reservoirs, Accumulation, Lakes, Insecticides, *Agricultural chemicals, Atrazine, Alachlor, Cyanazine, Dieldrin, DDE, Des Moines River, Rivers, *Iowa, Suspended sediments.

From September 1977 through November 1978 single 4-liter water samples were collected weekly or every 2 weeks beneath the surface and at mid-depth or near the bottom to estimate amounts of selected pesticides entering and leaving Saylorville Reservoir, a new partly filled impoundment on the Des Moines River in Iowa. Atrazine, alachlor, andd cyanazine, which have low affinity for suspended sediment and are highly soluble in water, were found only in the dissolved fraction of Des Moines River water. Atrazine levels in water ranged from 0 to 1,356 ng/1, with an overall mean of 223 ng/1. Alachlor concentrations ranged from 0 to 1,450 ng/1, with an overall mean of 89 ng/1. Cyanazine concentrations ranged from 0 to 660 ng/1 and followed a seasonal trend similar to alachlor, with higher levels occurring in June and July. Dieldrin concentrations in water ranged from 1 to 33 ng/1, and that compound was found in both dissolved and suspended fractions of river water. Dissolved p,p'-DDE levels were mostly less than 1 ng/liter, with suspended concentrations ranging from 0 to 66 ng/1 and averaging 7 ng/liter, with suspended concentrations ranging from 0 to 66 ng/1 and averaging 7 ng/liter. The estimated deposition in the reservoir from September 1977 to October 1978 was 281 kg atrazine, 251 kg alachlor, 26 kg cyanazine, 16 kg dieldrin, and 20 kg p,p'-DDE. (Baker-FRC)
W82-06871

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,
Geological Survey, Orlando, FL.
R. A. Miller, and H. C. Mattraw, Jr.
Water Resources Bulletin, Vol 18, No 3, p 513-519, June 1982. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Storm water, *Runoff, Water quality, Regression analysis, Land use, Basins, Fort Lauderdale, *Florida, Nitrogen, Phosphorus, Zinc, Oxygen demand, Mathematical studies.

Storm water runoff studies were made of three small basins in the Fort Lauderdale area of Florida to estimate annual loads through the use of linear regressions for a variety of water quality constituents, to define the range of constituent concentrations and loads typical of storm water in south Florida, to develop methods for transferring the information concerning concentrations and loads to other similar areas, and to meet information requirements of the various county and state agencies in Florida. Due to the large amount of data collected, a data management system was developed to store, analyze, and output data. Most of the storm water leaving the basins originated as rainfall on the hydraulically effective impervious area (HEIA). A large part of each of the constituent loads also originated on the hydraulically effective impervious area. Additional regression analysis showed that multiplicative models are superior to additive models for total residue and total lead. For total nitrogen, total phosphorus, total carbon, andd total zinc the additive models were superior to the multiplicative models. Total nitrogen and phosphorus HEIA yields were highest in the single family residential basin, whereas chemical oxygen demand and lead yields were highest in the commercial basin. In the highway drainage basin, total N and total P inputs exceeded outputs. Total zinc input exceeded output in both the highway and commercial areas. (Baker-FRC)
W82-06877

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, and L. J. Albright.
Applied and Environmental Microbiology, Vol 43, No 6, p 1227-1237, June, 1982. 2 Fig, 8 Tab, 25 Ref.

Descriptors: *Bacteria, *Heterotrophic bacteria, *Particulate matter, Amino acids, Glucose, *British Columbia, Salinity, Fate of pollutants.

The contributions of attached and free-floating bacteria to the bacterial numbers and heterotrophic uptake in 44 aquatic environments (marine, estuarine, lake, river, and creek) were studied in the southwest corner of British Columbia. Cluster analysis placed the 44 sites into five distinct environmental types based on three factors (salinity, heterotrophic uptake, and particulate load) which accounted for 53.6% of the variation. The five groups were: A, marine with low turnover times and low particulate load; B, marine, with high turnover times and no particulate load; C, fresh water with high turnover times; D, fresh water with a range of turnover times and heavy particulate loads. The order of clusters with increasing attached-fraction uptake of amino acids was A < B < E < C < D and for glucose, A < B < C < E < D. Clusters D and E had much higher bacterial counts than A, B, and C. Heavy particulate loads were associated with an increased percentage uptake of amino acids and glucose from the attached bacteria. In oligotrophic fresh water, uptake response was substrate specific. Amino acid uptake was more associated with the attached fraction; glucose uptake, with the free-floating fraction. (Cassar-FRC)
W82-06887

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,
Veterans Administration Medical Center, Pittsburgh, PA.
A. Brown, V. L. Yu, M. H. Magnussen, R. M. Vickers, and G. M. Garrity.
Applied and Environmental Microbiology, Vol 43, No 3, p 725-726, March, 1982. 15 Ref.

Descriptors: *Aerosols, *Human disease, *Bacteria, Microorganisms, Air pollution, Fallout, Sediment, Pneumonia, Legionella, *Tatlockia, Public health, Water pollution sources, Epidemiology, *Pittsburgh pneumonia agent.

The isolation of Tatlockia (Legionella) micdadei, the Pittsburgh pneumonia agent (PPA), from sediment obtained from a hospital shower is reported. Sediment was scraped with a sterile Dacron swab from the shower heads and mixing valves of 25 showers on 10 wards at the Pittsburgh Veterans Administration Medical Center. All recovered sediment was suspended in buffered yeast extract broth. Cultures were prepared and incubated aerobically and observed daily. Whereas several of the samples contained L. pneumophila, one contained a gram-negative rod which grew on the supplemented yeast extract agars but not on sheep blood agar. On the dye-containing buffered charcoal-yeast extract agar it grew as a blue-grey, nonfluorescing colony, typical of T. micdadei. It is suggested that the isolation of this organism from shower heads may be clinically significant because it provides further evidence that a water associated reservoir exists within the hospital. In addition, since an aerosol is produced by showering, this is a plausible source for the transmission of an organism producing pneumonia. (Baker-FRC)
W82-06891

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS).
Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.
P. K. Kearns, and R. J. Vetter.
Hydrobiologia, Vol 88, No 3, p 277-280, May, 1982. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Radioisotopes, *Accumulation, *Aquatic life, Fate of pollutants, *Manganese radioisotopes, Fish, Algae, Invertebrates, Radioactive wastes, Daphnia, *Chlorella, *Perch, Bioaccululation, Nuclear powerplants.

The concentration factor and biological half-life of Mn54 were determined in three members of a food chain. Green algae (Chlorella), Daphnia magna, and yellow perch (Perca flavescens) were exposed for 168 hours to water containing 5 micro Ci, 20 micro Ci, and 5 micro Ci of Mn54, respectively. Mn54 was added as necessary to keep the levels constant throughout the experiment. Concentration factors for algae, Daphnia, and perch were 4230, 17,000 and 11, respectively. The data suggest that these aquatic organisms can concentrate Mn54 rapidly, which could result in significant exposures to man. Nuclear power generation is one source of this radionuclide. (Cassar-FRC)
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,
Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
P.F.M. Verdonschot, M. Smies, and A.B. J. Sepers.
Hydrobiologia, Vol 89, No 1, p 29-38, April, 1982. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Oligochaetes, *Saline water intrusion, Chlorides, *Benthic fauna, Estuarine environment, *Brackish water, *The Netherlands, Scheldt Estuary, Deltas, Aquatic invertebrates, Salinity, Species composition.

Benthic macrofauna were sampled at 37 sites in the Delta region of The Netherlands (Scheldt Estuary) from January to June 1979. Waters in this unstable environment, below sea level and immediately behind the sea walls, have water temperature fluctuations of < 0 to > 20 C from winter to summer and sudden, irregular chlorinity variations up to 20 o/oo chloride at a single station. The distribution of the 23 species of oligochaetes was related to median chlorinity at the sampling station. There were 10 Tubificidae, 11 Naididae, 1 Lumbriculidae, and 1 Lumbricidae. Nais elinguis occurred throughout the chlorinity range. Oligochaetes formed two groups: brackish-marine and brackish-limnetic. The dividing line was about 1.5 o/oo

chloride. The brackish-marine group was resistant to high chlorinities and to wide fluctuations in chlorinity. (Cassar-FRC)
W82-06905

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,
Hong Kong Univ., Dept. of Botany.
L. L. P. Vrijmoed, I. J. Hodgkiss, and L. B. Thrower.
Hydrobiologia, Vol 87, No 2, p 143-160, 1982. 3 Fig, 7 Tab, 62 Ref.

Descriptors: *Coastal waters, Fungi, *Aquatic fungi, *Hong Kong, Salinity, Temperature effects, Acidity, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Nitrogen, Phosphorus, Light penetration, Sediments, Estuaries, Estuarine environment, *Marine fungi, Pearl River Estuary.

The effect of a range of environmental factors on the distribution of lignicolous marine fungi was studied in Hong Kong coastal waters. Five sites were chosen for study of the higher saprobic fungi of the lignicolous marine mycota. The Pearl River Estuary exerts an influence on the coastal waters especially during the wet season, when salinity, nutrient levels and the amount of sediment are affected. Throughout the year the average salinity increases, while the nutrient level and organic load decrease from west to east across the coastal waters. Among the 51 species recorded, 3 species remained unidentified. Of the 48 remaining species, 28 were considered either facultative or oligate marine forms; the remaining 20 species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species included Halosphaeria quadricornuta, Cirrenalia macrocephala, Cerioporopsis halima, and Trichocladium achrasporum. These species were found at all test sites. Regarding the abundance of species, frequency of occurrence and species composition of this group of more frequent lignicolous marine fungi, it appeared that two major patterns emerged. For mixed-mesohaline waters there was only one dominant fungus and many fortuitous species. For the mixo-polyhaline zones there was one dominant fungus and several important fungi co-existing but with fewer fortuitous species. There was no increase in the number of species nor any appreciable change in the Ascomycotina/Deuteromycotina ratio with increasing salinity. (Baker-FRC)
W82-06908

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBE-ASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).
Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
For primary bibliographic entry see Field 5C.
W82-06913

MICROBIOLOGY: WATER,
Environmental Protection Agency, Cincinnati, OH., Drinking Water Research Division.
E. E. Geldreich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 931-943, June, 1982. 173 Ref.

Descriptors: *Literature reviews, *Bioindicators, *Microbiological studies, *Reviews, Bacteria, Public health, Lakes, Impoundments, *Indicators, Water pollution effects, Environmental effects, Ecosystems, Rivers, Water pollution sources, Coastal waters, Corrosion, Water quality, Swimming pools, Drinking water, Antibiotic resistance.

Recent research in the area of water microbiological studies is cited in this review of the literature. Research into the use of microbial indicators of pollution included the development of multiple test kits for speciation of many waterborne aerobic and anaerobic organisms, changes in the heterotrophic bacterial density and subgroups as an indicator of qualitative changes in physicochemical characteristics of the Yodo River in Japan, the isolation of Aeromonas hydrophila from frogs and tadpoles, the potential human health hazard from toxigenic bacteria in water, the relationship between isolation of mycobacteria and classical microbiological and chemical indicators of water quality in swimming pools, bacteria in public water supplies, and the health risk of human exposure to wastewater. Microbial ecology of water was investigated in the light of solar radiation and naturally occurring microbial predators as important forces in the natural self-purification of polluted surface waters, short term exposure of E. coli to oligotrophic natural waters, the use of fecal indicators, biocumulation of copper and lead in aquatic life forms, the corrosion potential of four tropical Desulfovibrio desulfuricans isolates, microbial bioconcentration of organic pollutants from aquatic systems, and the microbial degradation of petroleum hydrocarbon. Much research was also conducted on the microbiology of river systems in coastal areas and on the microbiology of natural lakes and impoundments. (Baker-FRC)
W82-06924

MICROBIOLOGY: DETECTION, OCCURRENCE AND REMOVAL OF VIRUSES,
Louisiana State Univ., Baton Rouge, Dept. of Civil Engineering.
D. Roy, and M. E. Tittlebaum.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 984-986, June, 1982. 31 Ref.

Descriptors: *Literature reviews, *Viruses, *Reviews, *Microbiological studies, Water pollution control, *Pollutant identification, Path of pollutants, Bioindicators, Enteroviruses, Bacteriophage, Coliphages, Land disposal, Wastewater treatment, Shellfish.

Recent research in the area of detection, occurrence and removal of viruses is cited in this literature review. Detection methodology advanced in the areas of recovery of viruses from large volumes of water and wastewater using membrane filtration with microporous filters, in the efficiency of recovery of rotavirus from domestic wastewater by an adsorption elution technique followed by centrifugation, in the concentration of viruses from water samples using soluble ultrafilters composed of gelified alginate, in methods for concentrating bacteriophages from water and wastewater, in the recovery of viruses by elution from sludge flocs, and in the isolation of viruses using various concentration techniques. Survival of viruses was examined in systems following the transport of enteroviruses through sil at a wastewater irrigation site, in samples of wastewater, primary effluent and secondary effluent in Australia, in water to determine its effect on survival and transport of viruses into receiving waters and potentially back to humans, and in regard to the isolation of ribonucleic acid caliphages from raw wastewater samples in Japan. Research on the removal of viruses by treatment processes includes studies of the efficiency of waste stabilization ponds. Different factors were examined in the removal of viruses in soil-sludge systems, and the fate of sludge-associated viruses was investigated during sludge lagoon detention and after land application. Viruses were studied in shellfish, and indicators for viruses were sought. (Baker-FRC)
W82-06927

SOLID WASTES AND WATER QUALITY,
Envirodyne Engineers, Knoxville, TN.
G. R. Brower, and R. Ramkrishnadas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 749-754, June, 1982. 54 Ref.

Descriptors: *Literature reviews, *Solid wastes, *Reviews, Water quality, Industrial wastes, Municipal wastes, Waste disposal, Hazardous wastes, Radioactive wastes, Monitoring, Groundwater pollution, Environmental effects, Chemical analysis, Water analysis, Public health.

Current research in the field of solid wastes and water quality is cited in this literature review. The EPA groundwater protection strategy is defined. Environmental impact studies conducted on the Niagara River pollution, Salmonellosis occurrences in Scotland, volcanic ash leachate from Mt. St. Helens, and effects of waste disposal sites on groundwater quality are cited. Disposal of residues from solid waste treatment on ash ponds, by land application or through sanitary landfills was considered. The extent of contamination in groundwater of Missouri was investigated. Monitoring techniques used at waste disposal sites were described. Additional studies concerned with design, collection and attenuation included a study of the pollution threat to the water supply of Frederiksund, Denmark, the effect of differences of travel times in unsaturated zones between low and high leaching in groundwater table levels, factors affecting variations in phosphorus in irrigation return water, concentrations and losses of dissolved phosphorus from a tile drained silt loam before and after manure applications, and potential health problems associated with the presence of persistent organic chemicals in wastewater. In the area of characterization and treatment of solid wastes the chemical and mineralogical characterization of coal solid wastes was investigated along with the concentration of arsenic in coal ash, the chemical characterization of leachates from unretorted mined oil shales, and a comparison of analysis of leachate samples by different laboratories. Hazardous wastes were examined as to the behavior of such wastes in landfills, analyses of water and sediment samples near waste disposal sites, monitoring methods, regulations regarding hazardous waste disposal, and the denitrification of radioactive waste. (Baker-FRC)
W82-06929

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,
Michigan University, Ann Arbor, Great Lakes Research Division.
For primary bibliographic entry see Field 5C.
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,
Wisconsin University, Platteville.
For primary bibliographic entry see Field 5C.
W82-06938

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5C.
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
J. F. Lekan, and T. A. Coney.
Journal of Great Lakes Research, Vol 8, No 1, p 144-152, 1982. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, Mapping, *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, Nitrogen, Model studies, Mathematical models, Areal distribution, Path of pollutants, *Cladophora.

An intensive field and laboratory program was designed to gain a more complete understanding of the ecology of the alga Cladophora glomerata in Lake Huron. Key elements are a knowledge of the spatial distribution and seasonal growth characteristics of the organism. Remote sensing data were

obtained for a 2.8 km section of Lake Huron shoreline at Harbor Beach, Michigan. The data were collected using an eleven channel modular multispectral scanner mounted in an aircraft on a clear, calm day over the lake. Cladophora was determined by a conventional maximum likelihood statistical supervised classification technique employing three of the scanner bands. An intensive field survey of the study site indicated that the computer classified imagery is representative of the Cladophora distrbution at Harbor Beach. Classification accuracy was not determined, as the site was not mapped by ground surveys. The percent of areal coverage of model cells by Cladophora ranged from 0 to 93%. Calculations based on these percentages indicate that the alga occupies an area of 38,704 square meters at the study site. Overlapping flight lines resulted in duplicate measurements of many model cells. The reproducibility of results for these areas was good when suitable well defined Cladophora training sites are common to adjacent data sets. The reproducibility decreases in the absence of this condition. (Baker-FRC)
W82-06973

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,
McGill Univ., Montreal,(Quebec). Dept. of Biology.
R. Carignan, and J. Kalff.
Limnology and Oceanography, Vol 27, No 3, p 419-427, May, 1982. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Macrophytes, *Phosphorus, *Nutrients, Microorganisms, Microenvironment, Path of pollutants, Epiphytes, Hydrophytes, Aquatic plants, Microbiological studies, *Quebec, Lake Memphremagog, *Myriophyllum.

The use of fully labeled macrophytes in quantifying the importance of macrophytes to the phosphorus nutrition of their epiphytes, the release rates of phosphorus by Myriophyllum spicatum L., and the availability of the released phosphorous are discussed. The study was performed in Lake Memphremagog in a protected bay classified as mesotrophic with mean aestival total, soluble and soluble reactive phosphorus concentrations of 10.5, 2.2, and 0.5 micrograms/liter, respectively. The epiphytes of nine species of fully labeled macrophytes were collected between July and September 1977. The epiphytes derived only 3.4-9.0% of their P from the supporting macrophyte, indicating that previously suggested macrophyte-epiphyte nutrient interactions are of relatively minor importance. Although high diurnal P release rates were observed for the Myriophyllum-epiphyte complex, Myriophyllum accounted for only 9.9% of the total P released. The Myriophyllum-derived P was, however, released in a highly available soluble form. During the growing season, Myriophyllum thus appears to be principally important as a physical support for an active microbial community rather than as a P source to its epiphyton and surrounding waters. (Baker-FRC)
W82-06977

INVESTIGATION OF THE DISTRIBUTION OF WARM WATER DISCHARGE INTO SHALLOW WATER BODIES,
All Union Designing, Surveying, and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev.
Water Resources, Vol 8, No 4, p 378-388, July/August, 1981. 5 Fig, 16 Ref. Translated from Vodnye Resursy, No 4, p 77-90, July/August, 1981.

Descriptors: *Reservoirs, *Powerplants, *Thermal pollution, Fate of pollutants, Shallow water, Cooling ponds, Heated water, Nuclear powerplants, Water temperature, Temperature, Unsteady flow, Model studies, Numerical analysis, Air-water interfaces, Hydrothermal studies, Ponds, Reservoirs, Mathematical equations, *USSR.

The distribution of water temperature in unstratified water bodies impacted by warm water discharge was investigated by numerical modeling and by using hydrothermal models with a given function characterizing heat exchange at the water-air interface. Ordinary cooling ponds and water bodies at powerplants were examined. These are characterized by markedly unsteady flow. The equations were applied to the planned three-reservoir system in South Ukraine: Aleksandrovsk Reservoir, which will receive water from a nuclear power station through the Tashlyk Reservoir and ambient-temperature water from the Konstantinovka Reservoir hydroelectric station. Calculations showed that under the proposed operating regime, temperatures over the 28.1 C limit would prevail over 1/3 of the Aleksandrovsk Reservoir and a small part of the Konstantinovka. It was predicted that the entire cooling pond of the Smolensk nuclear power station would be 31-47 C during the hottest month of the year. (Cassar-FRC)
W82-06981

5C. Effects Of Pollution

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
D. Toetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243361, Price codes: A04 in paper copy, A01 in microfiche. Report, January 1982. 40 p, 8 Fig, 8 Tab, 25 Ref. OWRT A-091-OKLA(1), 14-34-0001-0138.

Descriptors: *Nitrogen, *Phosphorus, *Reservoirs, *Algal control, *Nitrogen fixing bacteria, Algae, Nutrient requirements, Lakes, Rivers, Reservoir operation, Water supply, Nitrogen compounds, Nitrogen fixation, Nitrogen cycle, Nitrates, Ammonia, *Oklahoma, *Lake Hefner.

Research was carried out to determine if low nitrogen (N) to phosphorus (P) ratios in Lake Hefner loadings were related to the development of populations of N-fixing algae in the lake. The hypothesis was also tested that, if N/P ratios in the lake loadings were 5 or less, N-fixing algae would contribute significant N amounts to the total lake budget; thus, the lake would compensate for low N/P ratios of the loadings. This lake is a terminal offset water supply reservoir (1044 ha area, 1.96 years residence time, 8.86 m mean depth), and is entrophic with a history of taste and odor problems in its finished water. All lake loading N/P ratios wrere 7.2, and N-fixing blue-green algae developed populations but did not fix substantial amounts of N (only 0.5% of total input). The concentrations of nitrate and ammonia in the euphotic zone probably suppressed N-fixation, hence, the lake responded as predicted. Annual loadings for P and N were 10 and 65 mg/sq m, respectively. Regulated flows from the North Canadian River (the major source of water for the lake) accounted for about 83% of the N and 93% of the P entering the lake annually. Precipitation contributed 15% and 6% of the N and P. respectively. River nutrient input to the lake represents the best control point for lake nutrient input to control lake water taste and odor. (Zielinski-MAXIMA)
W82-05912

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-05919

CARRYING CAPACITY FOR THE ILLINOIS RIVER,
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 6G.
W82-05927

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,
Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243577, Price codes: A06 in paper copy, A01 in microfiche. Report No 712437, January, 1982. 115 p, 10 Fig, 18 Tab, 207 Ref, 5 Append. OWRT B-079-OHIO(1).

Descriptors: *Cadmium, *Bacterial analysis, *Aquatic soils, *Heavy metals, *Toxicity, Sediments, Microorganisms, Water quality, Hazardous materials, Spectral analysis, Chemical analysis, Water analysis, Water quality control, Microenvironment, Environmental effects, Microbiological studies.

Research was conducted to examine how cadmium (Cd) may effect bacteria in laboratory microcosms and natural sediment populations. The study results demonstrated that the effects of Cd on natural sediment bacterial populations and on laboratory microcosm populations can be related; acclimation of bacteria to the toxic effects of Cd may occur in both systems. Bacteria of diverse biotypes could overcome Cd toxic effects after Cd exposure. However, bacteria in a laboratory water column were found to be more affected by Cd exposure than sediment bacteria. Absorption of Cd by bacteria and sediment showed higher absorption by bacteria than the sediment on a dry weight basis. The results provide an improved understanding of how Cd may influence bacteria in the environment and in other systems (e.g., waste treatment facilities), and of how bacteria may compete with particulate matter for available Cd in the water column and interstitial water. Bacterial uptake of Cd could result in the mobilization of Cd into the food chain where Cd accumulation might represent a potential human health hazard. Analyses of Cd were carried out by a reported atomic absorptoin spectrophotometry method. (Zielinski-MAXIMA)
W82-05934

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,
Beckman Instruments, Inc., Carlsbad, CA.
For primary bibliographic entry see Field 5A.
W82-05951

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,
Eco-Research Ltd., Inc., Point-Claire (Quebec).
For primary bibliographic entry see Field 5D.
W82-05955

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,
Genoa Univ. (Italy). Fisiologia Generale.
A. Viarengo, M. Pertica, G. Mancinelli, S. Palmero, and G. Zanicchi.
Marine Environmental Research, Vol 6, No 3, p 235-243, 1982. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Heavy metals, *Monitoring, *Water pollution effects, *Mussels, Bioindicators, Pollutant identification, Water quality, Chemical analysis, Coastal waters, Italy, Metabolism, Proteins, Stress, Cadmium, Mercury, Zinc, Copper.

Whether or not mussels collected from a heavy metal polluted area exhibited a stress syndrome which can be detected through variations in several biological parameters was studied. Species of Mytilus galloprovincialis Lam. were collected from La Spezia (polluted) and Portofino (unpolluted) from November 20 to December 5, 1979.The study demonstrated that the values of the rates of amino acid uptake and protein synthesis in the gills and digestive glands of the animals collected from the polluted area are significantly lower than those of the mussels sampled from the baseline area. The synthesis of RNA in nuclei obtained from the digestive gland of the mussels collected from the population of La Spezia was significantly reduced. Since temperature, salinity and pH values were similar in both areas studied and all animals were in

the same stage of the reproductive cycle, it is possible to speculate that the decrease in the values of the biological parameters examined reveals a stress syndrome which could be related to the increased metal concentration in the tissues of the mussels from the polluted area. The results allow the conclusion that mussels may be used as a self-integrating index of pollution in monitoring programs and indicate that the accumulation of pollutants in mussel tissues may result in a stress syndrome, as revealed by variations in several biological parameters. (Baker-FRC)
W82-05983

THE ACUTE TOXICITY OF MOTOR FUELS TO BRACKISH WATER ORGANISMS,
National Environment Protection Board, Studsvik (Sweden). Brackish Water Toxicology Lab.
M. Tarkpea, and O. Svanberg.
Marine Pollution Bulletin, Vol 13, No 4, p 125-127, April, 1982. 1 Tab, 3 Ref.

Descriptors: *Brackish water, *Fuel, *Toxicity, Seawater, Organisms, Aquatic organisms, Water pollution effects, Invertebrates, Methanol, Fish, Methyl tertiary butyl ether, Baltic Sea.

This study was performed to determine whether the acute toxicities to representative species from the Baltic Sea of blended fuels containing methanol or methyl tertiary butyl ether differed from those of base fuel, gasoline or low leaded gasoline. Alburnus alburnus (bleak) and the harpacticoid Nitocra spinipes were chosen as representative species. Low leaded gasoline, base fuel and blend fuel M15 15% methanol were rather highly acute toxic to the bleak. Of the three additives methanol, isobutanol and MTBE, the first was practically non-toxic, while isobutanol and MTBE were slightly toxic. Sublethal effects such as disturbed balance, surface swimming and overturning were noted in the bleak after only a couple of minutes of exposure to MTBE. Several individuals recovered before the experiment was ended. The 96 hour median lethal dose values for Nitocra spinipes varied between about 150 and 250 mg/liter for the actual motor fuels. For the bleak, the toxicity of the three additives was less than that of the actual motor fuels. The results of the study demonstrate that the acute toxicity of base fuel to aquatic organisms was not increased by the addition of 15% methanol of 5% MTBE. The risk of increasing the toxicity by the use of solvents with the potency of dissolving more of the hydrocarbons into the water phase was not verified in the experiment. (Baker-FRC)
W82-05985

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,
World Health Organization Schistosomiasis Control Project, Accra (Ghana).
D. Scott, K. Senker, and E. C. England.
Bulletin of the World Health Organization, Vol 60, No 1, p 89-100, 1982, 1 Fig, 9 Tab, 11 Ref.

Descriptors: *Epidemiology, Diseases, *Parasites, Schistosomiasis, Lakes, *Volta Lake, *Ghana, *Human diseases, Water pollution effects.

The prevalence of urinary schistosomiasis rose dramatically around Volta Lake within a year of full impoundment in 1968. During 1973-75 the incidence of the disease was investigated in 26 communities along 80 km of lake shore. In the total population 72.0% and 73.7% were infected in 1973 and 1974, respectively. Age, sex, and ethnic affiliation (indigenous Krobo farmers and immigrant Ewe fishermen) influenced the prevalence and intensity (egg output) of infection. In general, prevalence (over 90%) and egg output reached a peak in the 10-14 year age group and declined with increasing age. Males had higher egg outputs than females beginning in the 5-9 year age group and higher prevalence beginning in the 15-24 year age group. Egg output in the Krobos increased and decreased more rapidly with age than among the Ewe. Persons living in the Pawmpawm branch of the lake had lower prevalence (65%) and intensity of infection than those living among the Afram branch (80-84% prevalence). Transmission of the disease was greater from January to April during the period of high lake level and the early part of the drawdown. The number of infected Bulinus truncatus rohlfsi, the snail intermediate host, and the abundance of Ceratophyllum demersum, an aquatic weed closely associated with the snail, were highest in areas of highest human transmission and in seasons of highest human transmission. Human water contact was also correlated with intensity of infection. Children, males, Krobo children, and Ewe adults, more frequently in contact with water, had a correspondingly higher intensity and prevalence of the disease. (Cassar-FRC)
W82-05988

MALIGNANT MELANOMA AND DRINKING WATER CONTAMINATION,
Miami Univ., FL.
T. E. Aldrich, and A. J. Peoples.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 519-523, May, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Water pollution effects, *Human diseases, *Drinking water, *Organic compounds, *Mathematical studies, Water treatment, Chloroform, Chlorination, Municipal water, Model studies, Water analysis, *Epidemiology, Public health, Halogens.

When a major medical facility of Brevard County, Florida, reported potential clustering of malignant melanoma in 1975-1977, an investigation was carried out to see whether cases of this cancer could be significantly correlated with the trihalomethan (THM) levels in the municipal water supplies. Cluster analyses of data involved a cell occupancy method and an interval approach based upon the Knox model, involving definitions of spatial and temporal thresholds. Use of these techniques gave values extremely different from those calculated from the Third National Cancer Survey data. However, when the community experience was distributed according to population density, no clustering was observed. Results of the interval approach also showed no clustering. A dramatic north-south gradient of THM levels was generated from water analysis data. These data also indicate that increased THM formation in south Brevard County results from normal treatment of water. Blood sample analyses supported the north-south pattern of exposure, with high serum chloroform levels in areas where high THM levels existed in water. (Geiger-FRC)
W82-05989

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,
New York State Department of Health, Albany. Div. of Labs. and Research.
T. C. Lederman, and G. Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 388-394, March, 1982. 8 Fig, 22 Ref.

Descriptors: *Algae, *Inhibition, Growth rate, *Hexachlorobiphenyl, *Polychlorinated biphenyls, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, *Phytoplankton, Insecticides, Water pollution effects, Toxicity, Chlorophyll a, Nutrients, Phosphates, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

The effects of 2,4,5,2',4',5'-hexachlorobiphenyl (HCB) at low levels (0.,2-1.2 micrograms per liter) on the growth of algae were investigated in continuous culture under nutrient sufficient conditions and phosphate limited conditions. Under nutrient sufficient conditions only Fragilaria crotonensis growth rate was inhibited by cellular HCB concentrations as low as 0.8 micrograms per g dry weight. There was a dose-response relationship between cellular HCB and growth rate. Microcystis sp. and Ankistrodesmus falcatus growth rates were not inhibited by 3.6 and 11.5 micrograms per g dry weight or less, respectively, under nutrient sufficient conditions. Under P limiting conditions F. crotonensis, but not Microcystis and A. falcatus, showed growth rate inhibition. The pattern observed in F. crotonensis growth curves under P-limitation was a marked increase in cell numbers for 2 days followed by a decrease to levels lower than the control; this was not seen under nutrient-sufficient conditions. In both nutrient sufficient and nutrient limiting conditions in F. crotonensis cultures the cellular chlorophyll a concentration decreased with accumulation of HCB, and the C13 assimilation rate per unit chlorophyll a increased. Cellular P concentration in the P-limited cells also decreased with HCB accumulation. These results suggested that contamination with polychlorinated biphenyls can alter community composition in an aquatic environment. (Cassar-FRC)
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris, and R. A. Vollenweider.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 4, p 618-626, April, 1982. 1 Fig, 2 Tab, 62 Ref.

Descriptors: *Lakes, *Eutrophication, *Lake Erie, Great Lakes, Plankton, Phytoplankton, Limnology, Phosphorus, Seasonal variations, *Paleolimnology.

A reinterpretation is made of existing reviews of the changing assemblages of phytoplankton in Lake Erie in the light of new data on the history of phosphorus loadings to the lake, new information on the history of anoxia, and in terms of new data on the diatom remains in a core from the central basin of the lake. The picture that evolves from this re-evaluation suggests that Lake Erie had undergone initial eutrophication as early as 1850, although the main evolution toward a eutrophic system occurred during this century. Those persons concerned with water quality management should be aware that, for a given lake, the relationships between parameters such as total phosphorus, phytoplankton biomass, and the species of the assemblage are modifiable by processes operating on a scale of years, and that management schemes based on only a few years' data may need to be revised as new data become available. It is considered from this review that the initial disturbance to the metabolism of Lake Erie was the most important one in its eutrophis history. Events in the Lake Erie Basin over the last 50 to 60 years must be viewed in the light of these long term fluctuations and must be interpreted with great care. (Baker-FRC)
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,
Canada Center for Inland Waters, Burlington (Ontario).
P. T. S. Wong, Y. K. Chau, and D. Patel.
Chemosphere, Vol 11, No 4, p 367-376, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Algae, *Metals, *Toxicity, Water pollution effects, Heavy metals, Primary productivity, Productivity, Scenedesmus, Aminoisobutyric acid, *Great Lakes, Water quality standards, Phytoplankton, Nitrogenase activity, Synergistic effects.

A mixture of 10 metals at the Great Lakes Water Quality Objective individual levels reduced the primary productivity of cultured algae and a natural phytoplankton community from Lake Ontario. The metal levels (in micrograms metal per liter) in the full strength mixture were: As, 50; Cd, 0.2; Cr, 50; Cu, 5; Fe, 300; Pb, 25; Hg, 0.2; Ni, 25; Se, 10; and zn, 30. The full strength mixture reduced primary productivity to 31%, 45%, 37%, 45%, and 59% of the originaal levels in Scenedesmus, Chlorella, Anabaena, Navicula, and the natural community, respectively. Metal solutions of 0.1 and 0.5 of the original strength reduced productivity to a lesser degree. In Anabaena flos-aquae, an indicator of nitrogenase activity as reduced to 74% (not preincubated with metals) and 59% (pre-incu-

bated for 24 hours) by the full strength mixture and to 37% and 21%, respectively, by a 10-fold strength solution. The metal mixture also caused a reduction in reproduction and in transport of alpha-aminoisobutyric acid by Ankistrodesmus falcatus. (Cassar-FRC)
W82-05996

PERIPHERAL EFFECTS OF CADMIUM ON THE BLOOD AND HEAD KIDNEY IN THE BROWN BULLHEAD (ICTALURUS NEBULOSUS),
Bergen Community Coll., Paramus, NJ. Div. of Natural Sciences and Mathematics.
J. S. Garofano, and H. I. Hirshfield.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 552-556, May, 1982. 3 Tab, 8 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Catfish, *Monitoring, *Bioindicators, Kidneys, Blood, Heavy metals, Metals, Fish, Bioassay, Indicators, Pollutant identification, Fish toxins, Fish physiology, Absorption, Uptake.

Since the chemical leakage of cadium (Cd)-containing refuse can lead to the contamination of drinking water supplies, there is need for an accurate biological monitor for the presence of Cd in water. Studies were undertaken on brown bullhead catfish (Ictalurus nebulosus) to determine the amount and rate of Cd uptake via atomic absorption measurements and to determine whether acute Cd exposure (61 ppm) alters blood and head kidney cytology. Results showed that the peripheral blood cell differential counts and head kidney hemopoietic cell lines of indigenous fish species feeding in the area of a Cd-containing dump site provide the best immediate monitor for water quality. Chemical analyses demonstrate that the head kidney may be an initial target organ for Cd toxicity. The uptake, storage and clearance of Cd from the peripheral blood and head kidney are described for time periods of immediately after and 2 hr after exposure. (Geiger-FRC)
W82-06003

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,
Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
For primary bibliographic entry see Field 5A.
W82-06021

BIOASSY TRIALS WITH TWENTY THREE PESTICIDES TO A FRESH WATER TELEOST, SACCOBRANCHUS FOSSILIS,
D.A.V. Coll., Muzaffarnagar (India). Dept. of Zoology.
S. R. Verma, S. K. Bansal, A. K. Gupta, N. Pal, and A. K. Tyagi.
Water Research, Vol 16, No 5, p 525-529, May, 1982. 4 Tab, 15 Ref.

Descriptors: *Pesticides, *Fish, *Toxicity, Insecticides, *Bioassy, Carbamate pesticides, Halogenated pesticides, Organic pesticides, Organophosphorus pesticides, Water pollution effects, Saccobranchus fossils.

Toxicities of 23 pesticides were determined in static tests using the fresh water teleost, Saccobranchus fossilis. The acute toxic ranges and LC50 values for 24, 48, 72, and 96 hours and the relative potency with respect to abate, the least toxic pesticide, were listed for all pesticides. Active toxic ranges (mg per liter) were: thiotox, 0.0060-0.0085; thiodan, 0.0105-0.0132; heptachlor, 0.080-.118; chlordane, 0.32-0.72; aldrin, 0.42-0.85; lindane, 5.00-7.49; BHC, 2.00-3.99; phosalon, 0.083-0.88; quinalphos, 1.50-3.00; diazion, 1.00-3.99; dimehtoate, 4.50-5.90; dichlorvos, 6.00-10.00; Malatox, 7.99-14.00; thiometon, 750-13.96; fenitrothion, 10.00- 17.99; metasystox, 13.84-24.60; malathion, 15.00-20.00; leptophos, 20.00-29.00; dipterex, 29.0037.92; formothion, 140.00160-.70; abate, 200.00-240.20;carbofuran, 0.50-0.80; and carbaryl, 15.07-24.77. The relative order of toxicity was organochlorines > organophosphorus compounds > carbamates. Safe concentrations were listed for all 23 chemicals. These ranged from 4.9584 mg per liter for abate to 0.00014 mg per liter for thiotox. (Cassar-FRC)
W82-06031

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06032

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water Research, Vol 16, No 5, p 503-515, May, 1982. 8 Fig, 2 Tab, 32 Ref.

Descriptors: *Eutrophication, *Model studies, *Phosphorus, Nutrients, Water quality management, Lakes, Reservoirs, Limnology, Pollution load, Algae, Reviews, Nitrogen, Water pollution effects, Chlorophyll, Turbidity, Organization for Economic Cooperation and Development.

The Organization for Economic Cooperation and Development (OECD) undertook at 5-year study to quantitatively define the relationship between the phosphorus load to a water body and its eutrophication-related water quality response. This work resulted in the development of models by Vollenweider and others for use in water quality management programs. Since the completion of the study the OECD models have evaluated the P load-eutrophication response relationships for 40 U.S. water bodies in addition to the 34 previously studied. The remainder of the 200 water bodies investigated worldwide followed the general relationships of the OECD models, showing their wide applicability to different climates, water depths, water body sizes, and natural vs. manmade lakes. The most reliable water quality indicator is chlorophyll concentratin, with Secchi depth concentrations an adequate secondary parameter. A relationship has also been developed between P load and fish yield. At present several model constraints must be considered. The models are applicable only to water bodies in which algal growth is limited by P. They apply only to eutrophication as manifested by planktonic algal growth, not sanitary quality, toxicants, or siltation. Hydraulic residence time must be at least 2 weeks. Only small to moderate inorganic turbidity and color can be present. Other factors affecting model results are water level fluctuations, water withdrawals from the bottom, differences in load-response relationships in arms of a lake, and high suspended solids. (Cassar-FRC)
W82-06034

A METHOD FOR ESTIMATING THE RESPIRATION OF MUD COMMUNITIES IN SHALLOW RUNNING WATER,
Centre Univ. de Savoie, Chambery (France).
D. Fontvieille, and M. Renaud.
Water Research, Vol 16, No 5, 593-599, May, 1982. 5 Fig, 1 Tab, 25 Ref.

Descriptors: *Respiration, *Benthic environment, *Carbon dioxide, Organic matter, Sediments, Bottom sediments, Field tests, River beds, Aquatic life.

A system for determining the respiration of benthic fresh water communities by measuring their carbon dioxide production was evaluated in an organically polluted brook. Carbon dioxide production per unit of water surface decreased as the total carbon concentration of the mud decreased. Errors were greater in samples near the river bank than in those in the middle of the stream. The field apparatus consisted of an incubation chamber held in place by a tripod. Connections to the chamber allowed measurement of CO2 concentration, pH, and other parameters. Total organic matter levels in the experiment were 15,729-34,728 kcal per sq m, and CO2 production, 21.3-63.6 kcal per sq m per joule. (Cassar-FRC)
W82-06036

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06044

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWERPLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Ellis, and P. G. Mann.
Geological Survey Open-File Report 81-1196 (WRI), 1981. 90 p, 11 Fig, 7 Plates, 8 Tab, 14 Ref.

Descriptors: *Effluents, *Thermal powerplants, *Water pollution effects, *Water quality, Induced infiltration, Water storage, Groundwater, Wells, Groundwater movement, Data collections, Boron, Selenium, Fly ash, Chemical analysis, *Colorado, Yampa River basin, Lewis Shale.

Data were collected at the Hayden, Colo., powerplant for about a year during 1978-79 to monitor the effects of effluent and raw-water storage ponds on the local ground water, Sage Creek, and the Yampa River. The concentration of boron in wells downgradient from the effluent ponds indicated that the ponds were leaking, increasing the average boron concentrations in the ground water to a level in excess of the standards for agricultural use of water. Water from seeps, probably the best indicators of downgradient water quality, had average concentrations of boron two times that of the Colorado Department of Health (1977) standard for agricultural use of water. Chemical analyses of water from wells and the discharge weir downgradient from the raw-water storage ponds indicated these ponds are leaking. The effect of this leakage is that the water in wells downgradient from these ponds has a lower specific conductance and a lower boron concentration than the water in wells downgradient from the effluent ponds. The concentration of trace elements in the water from the wells and the discharge weir generally declined during the study, probably because the ground water was recovering from the effects of a plume from the raw-water pond previously used for fly-ash disposal. The effluents from the Hayden powerplant lowered the specific conductance and the iron and manganese concentrations, increased the concentration of boron, and had little or no effect on the selenium concentration in Sage Creek. Sage Creek had no discernible effect on the Yampa River because the volume of water in the Yampa River was so much greater. The effluents from the powerplant also had no discernible effect on the Yampa River. (USGS)
W82-06137

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5A.
W82-06146

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
J. C. Elliott, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243684, Price codes: A07 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and

Water Resources, University Park, Report, June 1982. 129 p, 18 Fig, 15 Tab, 62 Ref, 4 Append. OWRT A-003-PA(6), 14-34-0001-0140.

Descriptors: *Biomass, *Primary productivity, *Macrophytes, *Computer models, *Streams, *Simulation analysis, Aquatic productivity, Dissolved oxygen, Oxygen, Photosynthesis, Respiration, Benthic environment, Benthos, Aquatic life, Benthic flora, Model studies, Mathematical models, Mathematical studies, Computer programs, Shallow water, Water quality, Eutrophication.

A conceptual model for primary productivity was developed for application to rooted aquatic macrophytes in streams to assist studies of eutrophication and control of water quality in supplementing outputs of dissolved oxygen (DO) models of pollution loads. This model included a first-order differential equation of biomass, with specific rates for photosynthesis, respiration, and death. A model component was developed to describe available light spatially/temporally in the weed bed, as reduced from extraterrestrial solar radiation. A DO model component included terms for photosynthetic production, plant respiration, and a benthal sink due to dead plant matter decay. The latter, a first-order exponential oxygen sink, had not been previously included in DO models. Model parameters and growth rates were determined for a Pennsylvania creek plant population. Data analysis required simulating the plant biomass throughout an annual cycle for each creek reach using stoichiometric relationships between DO productivity and biomass. Simulation was achieved by computer analysis, refined by comparison with selected evaluation criteria for population dynamics and growth rates versus environmental conditions. The model was applied to the study system and tested for sensitivity to variations in basic model parameters. The computer programs for the model are delineated. (Zielinski-MAXIMA)
W82-06153

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,
Georgia Inst. of Tech., Atlanta. School of Biology.
A. C. Benke, G. E. Willeke, F. K. Parrish, and D. L. Stites.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254905, Price codes: A04 in paper copy, A01 in microfiche. Georgia Environmental Resources Center, Atlanta, Report ERC 07-81, November 1981. 64 p, 22 Fig, 12 Tab, 16 Ref, 2 Append. OWRT A-055-GA(1).

Descriptors: *Urbanization, *Water quality, *Nonpoint pollution sources, *macroinvertebratees, *Water analysis, Aquatic populations, Watersheds, Streams, Aquatic life, Fauna, Aquatic animals, Ecosystems, Water stress, Urban planning, Urban areas, Urban runoff, *Georgia, Atlanta.

The effects of urbanization on 21 stream ecosystems were studied in the Atlanta area in 1-3 sq mile watersheds varying from 3-100% green space, from 0-98% residential-commercial, and with house densities from 0-941 sq miles. The primary index of stream quality was community composition of aquatic macroinvertebrates. The streams were in a single area where physico-chemical conditions and composition of macroinvertebrates should be very similar under natural conditions. While there were widely-varying degrees of urbanization, pollution (as indicated by standard water quality measures) was not at all obvious, and differentiation of stream communities was more subtle than is often encountered in studies of gross pollution. A significant relationship was found between urbanization and number of species/families (but not with species/family diversity, indicating less utility for a diversity index). Hence, identifying macroinvertebrates to the family level is sufficient in assessing differing degrees of stress in streams. Cluster analysis distinguished three major groups of streams: clean, intermediate, and degraded. High residential land use, low levels of green space, and high house densities were associated with degraded streams. (Zielinski-MAXIMA)
W82-06165

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
R. L. Meyer, and N. Woomer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254921, Price codes: A03 in paper copy, A01 in microfiche. Publication No 80, September 1981. 28 p, 1 Fig, 3 Tab, 24 Ref. OWRT A-053-ARK(1). 14-34-0001-0104.

Descriptors: *Benthic flora, Water sampling, *Water analysis, *Algae, *Baseline studies, Benthic environment, Benthos, Aquatic life, Aquatic plants, Aquatic populations, Ecosystems, Biological samples, Water quality, Streams, Algal growth, Algae harvesting, Seasonal variation, Pollutant identification.

Stream biota response to changing water quality or other ecosystem perturbations is an important means of assessing water quality, but the dynamic nature of streams produces significant sampling/measurement problems. However, smaller streams lack a true algal plankton subcommunity and attachment to stones and other stable surfaces at the substrate-water interface represents the major location for algae production. A newly-developed substrate sampler, composed of portland cement, was tested to determine residence time, qualitative similarity between natural/sampler populations, methods for determining primary algae production roles, seasonal succession, and colonization rates. This new approach has been applied, for comparative purposes, to two streams: one influenced by treated municipal sewage; the other, a non-impacted stream. It was determined that the concrete hemispherical samplers are colonized by the same algae in generally the same proportions as those found in adjacent natural rock substrates. These samplers are comparable in size, texture, shape, placement, and position, to the natural rock substrate in this streams study, and are applicable for inter-stream studies. Physical and chemical stream water quality data, biological data, and algae production data are presented. (Zielinski-MAXIMA)
W82-06168

EFFECTS OF APPLE ORCHARD RUNOFF ON THE AQUATIC MACROFAUNA OF A MOUNTAIN STREAM,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
D. L. Penrose, and D. R. Lenat.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 383-388, 1982. 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Pesticides, *Invertebrates, *Orchards, Water pollution effects, Endrin, Species diversity, Cox Creek, *North Carolina, Macroinvertebrates, Benthic fauna, Apples, Nonpoint pollution sources.

The effects of pesticides in apple orchard runoff were determined at three stations in Cox Creek, North Carolina. Aquatic macroinvertebrates were sampled 10 times from March 1977 to March 1978. The control site, No. 1, was upstream of the orchards; sites 2 and 3 were within and downstream of the orchard area. Stations 2 and 3 showed moderate to severe stress in the macroinvertebrate populations. Numbers per sample were: control, 274; Site 2, 253; and Site 3, 65. Taxa richness indexes were: control, 37.9; Site 2, 30.2; and Site 3, 12.6. Diversity indexes were: control, 3.2; Site 2, 2.9; and Site 3, 2.4. Biotic index values developed by a North Carolina biological monitoring group were: control, 2.3; Site 2, 2.2, and Site 3, 2.7. Periods of low taxa richness and diversity wre associated with spring cover spraying and fall after-harvest sprays. Station 3 was a permanently stressed area, whereas Station 2 goes through repeated stress and recovery. Plecoptera were especially sensitive to apple orchard runoff. Organisms dominant at Station 3 included several stress tolerant species. (Cassar-FRC)
W82-06177

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,
Istituto di Ricerca sulle Acque, Milan (Italy).
G. Chiaudani, and M. Vighi.
Water Research, Vol 16, No 7, p 1161-1166, July, 1982. 5 Fig, 23 Ref.

Descriptors: *Nutrients, *Coastal waters, Eutrophication, Phosphorus, Nitrogen, Phosphatase, *Adriatic Sea, *Algal growth, Pollutant identification.

This study was planned to make use of several approaches to the problem of identifying algal growth-limiting nutrient. The time course of total and free specific phosphatase activities and the changes in soluble reactive phosphorus concentration during algal growth under three different experimental conditions were examined. In cultures grown in medium without phosphorus, phosphatse activity, both total and free dissolved, showed a large increase during the first 7 days, and at the 7th day free phosphatase activity represented 40% of the total activity. In control cultures and in cultures grown in medium without nitrogen, specific phosphatase activities were always detectable, but at very low levels. Phosphorus addition in phosphorus starved cultures caused a drastic drop in the phosphatase activity, reaching levels of control cultures after 3 days. A drop in phosphatase activity of 85% was noted in 24 hr following phosphorus addition. No difference in algal growth rate was noted in cultures spiked with organic or inorganic phosphorus because organic phosphorus quickly became available by means of enzymatic hydrolysis. It was concluded from this study that the most useful indicators of specific nutrient deficiency that can be applied to natural waters are the measurement of phosphatase activity and estimation of the ammonium ion enhancement ratio. Field study results indicated that the phytoplankton populations were phosphorus limited. Nitrogen deficiency was never found during the whole sampling period. (Baker-FRC)
W82-06267

HEAVY METALS IN ANIMALS OF LAKE BALATON,
Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
J. Salanki, K. V.-Balogh, and E. Berta.
Water Research, Vol 16, No 7, p 1147-1152, July, 1982. 1 Fig, 8 Tab, 11 Ref.

Descriptors: *Lakes, *Heavy metals, Cadmium, Copper, Manganese, Iron, Zinc, Mercury, Lead, Aquatic animals, Monitoring, Water quality, *Hungary, Lake Balaton.

The concentrations of mercury, cadmium, lead, copper, iron, manganese, and zinc were investigated in mid-living larvae, in zooplankton, and in various organs of bivalves and fish and in the water of Lake Balaton, situated in the western part of Hungary. This lake is the largest shallow lake in Europe, with a surface area of 600 square kilometers and a water content of about 1.8 cubic km. The highest mercury levels were in Chironomidae larvae. Comparatively high concentrations were found in crustacean plankton, in the gills of the mussels and in the kidneys of the fish. Cadmium concentration was highest in the gills of the mussel. Copper concentrations were high in the liver of Abramis brams L. and in the crustacean plankton. The lead concentration was highest the gills of Anodonta. Zinc values were highest in the gills of mussels, highest iron concentrations occurred in Chironomidae larvae, and manganese was extremely variable. The concentration factors (tissue levels vs. water levels) characteristic of Anodonta and Unio underline the importance of mussels in biomonitoring. (Baker-FRC)
W82-06284

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,

Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
Water Science and Technology, Vol 14, No 3 p 137-143, 1982. 19 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Reviews, Environmental effects, Sedimentation, Heavy metals, Metals, Pathogens, Dissolved oxygen, Water pollution effects, Public health, Shellfish, Aquatic life, Benthic fauna, Nutrients, Zooplankton, Phytoplankton, Fish, Organic matter.

A review of sludge disposal at sea by ships concerns the environmental effects on the sea surface, water column, and sea bottom. When sludge is dumped from a ship, the primary effects are a transient surface slick, a turbid plume, and deposition on the sea bottom. Little is known about the effects of sludge dumping on the neuston (surface community of organisms). but significant damage is unlikely. The water column contains increased nutrient levels. However, algal blooms sometimes attributed to sludge dumping grounds are often a result of input from rivers. Reduced dissolved oxygen has been recorded seasonally below the thermocline. The finely divided organic material serves as food for planktonic organisms. The main impact of sludge dumping is on the sea bottom. Dumping grounds are classified, although not rigidly, as accumulating and dispersing. Effects are most noticeable in accumulating dumping grounds. The sediment increases in organic content and may be deoxygenated below the surface, replacing the normal benthic community with a low diversity, high biomass assemblage, mostly worms. Toxic heavy metals and organochlorines accumulate in the dumping grounds and enter the food chain. Thus far, levels in seafood products have not been harmful. Pathogens may present a hazard to public health by contaminating shellfish. Some fin fish diseases are associated with sewage exposure. Impacts of sludge dumping on the ecosystem are generally local and reversible. (Cassar-FRC)
W82-06287

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,
Coastal Water Research Project, Long Beach, CA.
W. Bascom.
Water Science and Technology, Vol 14, No 3, p 41-52, 1982. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Environmental effects, Santa Monica Bay, California, Outfalls, Invertebrates, Fish, Aquatic animals, Toxicity, Canyons, Species distribution, Species diversity.

A steep-sided submarine canyon in Santa Monica Bay, California, has received about 1.25 million metric tons dry weight of sewage sludge over the past 22 years. Near the discharge at 100 m depth 41 species of fish and 40 species of invertebrates were found. Dominat species of fish at the outfall were soles, rockfish, croakers, sanddabs, perch, combfish, ratfish, and plainfin midshipman. Water was moderately clear away from the pipe. The ecosystem in a 3 sq km area of the canyon has experienced both beneficlal and detrimental changes. Species numbers are greatly reduced, sometimes to as few as 10, and the Infaunal Trophic Incexes often reach zero. At most of the canyon stations the number of individuals and the biomass was almost double that at the control stations. However, species are limited to those which can utilize the sludge as food. Individual fish were larger in the canyon area. (Cassar-FRC)
W82-06290

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,
Verlag Chemie, Weinheim (Germany, F. R.).
H. Bernhardt.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 14-26, February, 1981. 14 Fig, 7 Tab, 67 Ref.

Descriptors: *Water quality control. *Water pollution prevention, *Eutrophication, *Phosphorus removal, *Wastewater treatment, Drinking water, Nutrient removal, Filtration, Reservoirs, Nitrogen, Water suply, Water pollution control, Water pollution effects, Potable water.

The causes of eutrophication of still waters are reviewed along with processes for reducing phosphorus levels in the effluents of urban sewage treatment plants. Methods of contact filtration, chemical precipitation and adsorption of phosphorus compounds and the biological elimination of phosphorus and nitrogen are described. The international OECD investigation program was applied in calculating the tolerable phosphorus load of lakes and drinking water supply reservoirs in relation to the morphological conditions of the water bodies. Seepage filtration which reduces phosphorus input into reservoirs and lakes is examined. Alumina filtration is used to treat the effluents of fish hatcheries. The Wahnbach Reservoir Association has designed a process to eliminate phosphorus contributed from large tributaries of a reservoir. Similar measures which are utilized in the lakes of West Berlin that supply potable water are discussed. (Geiger-FRC)
W82-06299

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,
Kansas Water Resources Research Inst., Manhattan.
F. deNoyelles, and D. Kettle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256504, Price codes: Axx in paper copy, A01 in microfiche. Contribution No 219, December 1980. 48 p, 1 Fig, 15 Tab, 59 Ref. OWRT A-092-KAN(1), 14-34-0001-8018.

Descriptors: *Herbicides, *Aquatic weed control, Pollutants, Water pollution effects, *Agricultural runoff, *Atrazine, Kansas, *Aquatic food chains, *Phytoplankton, *Triazine herbicides, *Photosynthetic inhibitors, Zooplankton, Fish, Experimental ponds.

Experimental ponds were used for studying the effects of an agricultural herbicide on aquatic food chains. Atrazine, one of the most heavily used herbicides in Midwest agriculture, was added to ponds and the ensuing responses were followed through four months. With single 20 mu g/liter additions to the ponds, effects were recorded throughout the food chain. After one day of exposure rates of phytoplankton photosynthesis declined at both levels, with the higher level causing an almost complete inhibition. Phytoplankton succession was altered within a few days at both levels, with resistant species increasing in abundance. The actual resistance of these species to atrazine, which is known to be a photosynthetic inhibitor affecting a wide variety of plants, was verified in the laboratory. The grazing zooplankton were also affected within the first few weeks of exposure as their phytoplankton food source was altered. The growth of aquatic flowering plants was also reduced at both levels. Some members of the aquatic food chain were unaffected, particularly the benthic insects, although effects were recorded at the highest level of these food chains, the fish. Of the three types of fish (bluegill sunfish, channel catfish, gizzard shad) originally stocked in the ponds, all survived but with reduced growth at the 500 mu g/liter level. The only fish to reproduce in the ponds, bluegill sunfish, showed greatly reduced numbers of progeny at both levels. The concentrations of atrazine in the ponds were monitored, showing its persistence with 75% of the original concentration present after 114 days. In Midwest waters concentrations of 500 mu g/liter are recorded in waters directly associated with agricultural operations, such as irrigation waters while 20 mu g/liter is at the high extreme of concentrations found more widespread. Though data from monitoring atrazine concentrations in natural habitats is sparce 1 mu g/liter to 5 mu g/liter seem common in many Midwest waters. In laboratory experiments with these more common concentrations we also demonstrated reductions in phytoplankton phytosynthesis. This indicates the possibility, awaiting further demonstration, that even at common concentrations atrazine may be affecting phytoplankton photosynthesis in many Midwest waters. Other herbicides studies in this project included 5 other triazine herbicides (propazine, metribuzin, terbutryn, cyanazine, simazine) which in the laboratory were similar to atrazine in the intensity of reducing phytoplankton photosynthesis. In the State of Kansas triazine herbicides accounted for one-third of the total herbicide usage in 1978.
W82-06304

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-06310

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,
Arhus Amtsvandvaesen (Denmark).
J. M. Andersen.
Water Research, Vol 16, No 7, p 1119-1126, July, 1982. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Eutrophication, Phosphorus removal, *Phosphates, *Nitrates, Nitrogen, Sediments *Lake sediments, Hypolimnion, Thermal stratification, Stratification, Nutrients, *Denmark.

Results are given of eutrophication investigations in some 31 Danish lakes, focusing especially on the relationships between the concentration of oxidized nitrogen in the lake water and the binding or release of phosphorus to or from the lake sediment. Nine lakes were dimictic, with anoxic hypolimnia, and 22 were very productive and shallow polymictic lakes. Phosphate release from the sediment resulted in large increases in phosphate concentrations in the anoxic hypolimnion, if concentrations of oxidized nitrogen in the hypolimnion were less thant about 0.1 g N/cubic meters. If concentration of oxidized nitrogen in the hypolimnion was about 1 g N/cubic meter or higher, no release of phosphate from the sediment to the anoxic hypolimnion occurred. In lakes with no summer stratification a release of phosphate from the sediment to the well oxygenated water resulted in summer maxima of phosphate in the lake water when nitrate concentration in the water was less than about 0.5 g N/cubic meter, but no release took place if nitrate concentration exceeded about 0.5 g N/cubic meter. This effect of oxidized nitrogen in preventing phosphate release from the sediment demonstrates the ability of oxidized nitrogen to buffer the redox potential of the surface sediment at a level high enough to prevent a release of phosphate. Thus, among the efforts to limit phytoplankton biomass in lakes an artificial enrichment with nitrate may in some cases be an important supplement to the usually necessary reduction in phosphorus loading, but the possibility of a stimulation of phytoplankton growth through the addition of nitrate must be carefully considered. (Baker-FRC)
W82-06313

SOME EFFECTS OF PULP AND PAPER WASTEWATER ON MICROBIOLOGICAL WATER QUALITY OF A RIVER,
Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, S. Janhurst, and G. Horsnell.
Water Research, Vol 16, No 7, p 1291-1295, July, 1982. 3 Tab, 20 Ref.

Descriptors: *Water quality, *Industrial wastes, Rivers, Water pollution effects, *Pulp and paper industry, Bacteria, Public health, Recreational facilities, Fecal bacteria, Coliforms, Escherichia coli.

The source of fecal indicator bacteria was sought in a river downstream from Sturgeon Falls. A small sewage treatment plant treating 1 million gallons per day and serving the town of Sturgeon Falls discharges effluent to the river 2 km below the falls. Two 5-day bacteriological water quality surveys were carried out between June 25 and 29,

and August 10 and 14, 1977. Data were obtained from samples taken at 40 river locations. Above Sturgeon Falls the water quality in the river was fairly good. The principal input of fecal indicator bacteria was traced to the paper mill at Sturgeon Falls; however, other sources of indicator bacteria could have been masked by the large numbers of bacteria discharged by the mill. The principal fecal coliform was Klebsiella pneumoniae. In pulp mill wastes the fecal origin of this bacterium can be disputed. K. pneumoniae can cause illness in humans. Pseudomonas aeruginosa was detected in the pulp mill wastewater and at a level of 82 PA/100 ml in recreational waters. This level was considered hazardous to the water users. Escherichia coli was detected in mill wastewater at about 200 EC/100 ml; this probably indicated some measure of fecal pollution though probably of animal origin. Finally, the nutrient-rich wastewater led to an about 50-fold increase in density of aerobic heterotrophic bacteria in the river water, as well as the production of a slimy filamentous growth on surfaces, stones, and wooden pilings in the river. The principal organism in this slime was the fungus Leptomitus. (Baker-FRC)
W82-06315

THE IMPACT OF COMBINED SEWER OVERFLOWS ON THE DISSOLVED OXYGEN CONCENTRATION OF A RIVER,
Aalborg Univ. (Denmark). Dept. of Environmental Engineering.
T. Hvitved-Jacobsen.
Water Research, Vol 16, No 7, p 1099-1105, July, 1982. 10 Fig, 10 Ref.

Descriptors: *Dissolved oxygen, Rivers, *Storm water, *Storm-overflow sewers, Storm runoff, Storms, *Combined sewer overflows, Storm wastewater, Oxygen, *Denmark, Skravad River.

The impact on the water quality of receiving streams was studied for combined sewer overflows in Denmark. The investigation was carried out in the river Skravad, a small tributary to the river Skals located in the middle of Jutland, Denmark. The total length of the Skravad River is 25 km; the part studied has a length of about 4 km, and on the average a width of 2.5 meters and a depth of 0.25 meters. About 5.5 km upstream from the confluence with the Skals River the stream receives biologically treated wastewater from the Moldrup sewage treatment plant. Moldrup township has a combined sewerage system and covers an area of about 70 ha. The storm overflows discharge through a ditch to the river Skravad just downstream from the outfall from the sewage treatment plant. Immediate oxygen comsumption takes place during the passage of the bulk discharge due to degradation in the water phase and absorption at the bed. A delayed effect was noted on the dissolved oxygen concentration due to the degradation at the bed of settle particulate matter and/or adsorbed organic matter. The observed effect cannot be due to the delay of polluted water in the dead zone volume of the stream. Depending on the actual adsorption, sedimentation, desorption and resuspension, the observed delayed effect on the dissolved oxygen concentration will vary from one discharge event to another. The flow conditions in the stream may also be important. Due to the delayed effect, the oxygen depletion extends over a longer period than just the duration of the overflow. In the investigated river the oxygen concentration returned to dry weather conditions within 12-24 hours. (Baker-FRC)
W82-06316

THE EFFECT OF BOAT ACTIVITY ON TURBIDITY IN A SHALLOW BROADLAND RIVER,
Freashwater Biological Association, Windmere (England).
J. Hilton, and G. L. Phillips.
Journal of Applied Ecology, Vol 19, No 1, p 143-150, April, 1982. 4 Fig. 2 Tab, 7 Ref.

Descriptors: *Turbidity, *Boating, Rivers, Lakes, Recreation facilities, Water quality, Model studies, Mathematical equations, Algal growth, Eutrophication, Water pollution sources.

A new approach was developed to explain the possible mode of action of boat activity in a narrow, shallow river and by its application, answer some problems of recreational management. The study site was the River Ant, a tributary of one of the principal Broadland rivers, the River Bure. The river flows throught Barton BroaD, a shallow lake of 1 meter in depth, 70 ha in area. During the summer the Broad and the river downstream contain a very high standing crop of phytoplankton. Above the Broad very little phytoplankton develops. the river is navigable for several miles above the Broad, and two large boat-hire yards are located in these upper reaches. Boat activity throughout the navigable reaches can be as high as 100 boats moving per hour. A simple experimental model was proposed and tested. It describes the mechanism by which boats can influence turbidity. Of the three constants derived from the model, two were shown to be closely related to measured physical variables. The model was used to predict water turbidities from typical boat movement patterns. This demonstrated that long term buildup of boat-induced turbidity through the holiday season was unlikely and that the major part of the turbidity in and below Barton Broad on the River Ant was due to algae and not to boating activity. (Baker-FRC)
W82-06330

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,
Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, B. Keswick, R. L. LaBelle, C. P. Gerba, and Y. Sanchez.
Journal of the American Water Works Association, Vol 74, No 6, p 318-321, June, 1982. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Well water, *Human diseases, Drinking water, Bacteria, Potable water, Contamination, Leaching, Gastroenteritis, Hepatitis, Viruses, *Kentucky, Georgetown.

This report describes the Georgetown experience of an outbreak of gastroenteritis and hepatitis in order to illustrate the problems of viral contamination of small community water supplies. This marks the first reported instance of hepatitis A virus (HAV) antigen detection in well water samples taken prior to a hepatitis epidemic. In June of 1980 an outbreak of gastrointestinal illness occurred in the town. The outbreak began on June 1 and was over by June 23, with the peak number of cases occurring on June 13. Illness was associated with drinking of water from the central city wells. The attack rate among the 10,000 people living in areas supplied by these wells was about 79%. An increase in the number of cases of hepatitis A began to appear in July of that year. Again the cause was traced to central city wells. Heavy rainfalls had preceded the outbreaks of both gastroenteritis and hepatitis. Samples were taken from sewage, well water, and tap water for virological analysis. It was concluded that the Georgetown outbreak may have occurred due to heavy fecal contamination of the groundwater source near the central-city wells. What would normally be adequate treatment for an uncontaminated groundwater source was clearly inadequate when that source became unexpectedly contaminated. Human enteric viruses were isolated from the potable water in spite of a total chlorine residual of 0.8 mg/L. Sources of the contamination may include leakage from nearby sewer lines, contamination from nearby abandoned or private wells or septic tanks, and relatively long-distance contamination from surface contaminants in the recharge area of the Edwards aquifer. There is a fault line in the area adjacent to the wells and the aquifer is exposed to the surface just west of the fault line. (Baker-FRC)
W82-06348

ANTAGONISM OF SELENIUM AND CADMIUM PRETREATMENTS TO SUBSEQUENT EMBRYOTOXIC DOSES OF MERCURY AND CADMIUM IN FISH EMBRYOS,
South Dakota Univ., Vermillion. Water Resources Inst.
J. F. Heisinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256645, Price codes: A02 in paper copy, A01 in microfiche. Report, December, 1981. 20 p, 2 Fig, 1 Tab, 31 Ref. OWRT A-075-SDAK(1). 14-34-0001-0144.

Descriptors: *Selenium, *Liver, *Embryonic growth stage, *Heavy metals, *Fish toxins, Mercury, Cadmium, Toxicity, Trace metals, Trace elements, Trace levels, Fish, Water pollution, Pollutants, Environmental protection, Fish populations, Population exposure.

Research was carried out to assess the protective role of selenium (Se) and cadmium (Cd) pre-exposures to fish embryos in attentuating toxic doses of mercury (Hg) and Cd. Experiments were carried out under laboratory-controlled conditions using Japanese ricefish (Oryzias latipes). Results indicated a protective role of Se pretreatment against Hg and Cd exposures in fish embryos once the liver has developed. In addition, pretreatment of post-liver embryos with sublethal concentrations of Cd also affords protection against subsequent potentially lethal Cd exposures. These antagonistic interactions, however, appear not to occur prior to liver development. Since numerous antagonistic metal and metalloid interactions have been reported in adult vertebrates, and since it is established that most metal-polluted waters contain anomolous quantities of more than one toxic element, it might be expected that the toxicity of these waters would be less than the sum of the toxic effects of the individual metals. However, during early embryo development the requisite morphological and molecular characteristics for antagonistic interactions appear to be lacking; consequently, younger embryos will lack sufficient resistance to multiple toxic metal exposures and lethality may occur. The results confirm the hypothesis that, during early embryonic development, the protective effects of Se or Cd will be nonexistant or minimal. (Zielinski-MAXIMA)
W82-06371

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.
Organization for Economic Co-Operation and Development, Paris (France).
Report, 1982. 154 p, 46 Fig, 24 Tab, 154 Ref, 7 Append.

Descriptors: *Eutrophication, *Eutropic lakes, *Water quality control, *Phosphorus removal, *International commissions, Algal growth, Aquatic productivity, Inland waterways, Water quality, Phosphorus, Nutrient removal, Nutrients, Nitrogen, Monitoring, International agreements, Trophic level, Lake morphology, Limnology.

The principal results are presented of a multi-year, 18-country international cooperative program aimed at establishing a basis for eutrophication control of inland waters (especially lakes and reservoirs) and developing improved guidelines for fixing nutrient load criteria compatible with water use objectives. The program was carried out by establishing four main regional projects covering a wide variety of geographic and limnological situations (Alpine; Nordic; reservoir and shallow lakes; and North Anerica); a fifth report has been developed which tests the results on bodies of water not included in the analytical part. The main control strategy offered is reduction of the external load; where this is impractical/impossible, alternate management measures are necessary which can only be defined using advanced modeling techniques. While nitrogen (or another factor) may occasionally outweigh the role of phosphorus (P) as the limiting factor, attention is focused on phosphorus control. The program results showed that, in most cases, P is the factor which determines eutrophication development; even when another element (e.g., nitrogen) is the limiting factor, P may still be made to play the limiting factor role through appropriate control. Specific findings concerning monitoring, nutrient load assessment, trophic assessment, and loading criteria and nutrient

reduction goals are discussed. (Zielinski-MAXIMA)
W82-06383

STUDIES OF BOD INHIBITION IN PRESENCE OF INORGANIC HEAVY METALS,
Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 111-113, June, 1981. 4 Tab, 5 Ref.

Descriptors: *Biochemical oxygen demand, *Chemical interference, Water Analysis, *Heavy metals, Toxicity, Water pollution effects, Inhibition, Biodegradation, Cadmium, Chromium, Mercury, Coppper, Dissolved oxygen, Sewage bacteria, Industrial wastes.

The method of estimating biochemical oxygen demand (BOD) on the basis of rate of oxygen consumption may lead to erroneous results when inorganic toxicants, either individually or in combination, are present in samples of sewage or polluted water. Copper (Cu), chromium (Cr), cadmium (Cd), mercury (Hg), and other electroplating wastes may kill the microbial population in the sample, leading to a reduced depletion of dissolved oxygen concentration. BOD inhibition due to Cu, Cr, Cd, and Hg, individually and in combination, was determined by adding different concentrations of the metals for different dilution factors of sewage and dilution water. Toxicity behavior analysis showed that percent inhibition of BOD fluctuated for concentrations of 0.01 to 0.1 ppm for all of the toxicants. For 0.01 to 0.1 ppm levels of the metals, toxicity to microbial populations was within the range of 25% inhibition of BOD. For the concentration of 0.1 to 1.0 ppm, Cr seemed to be the least toxic and Hg the most. In the case of each metal tested, biodegradation activity as almost soppped in the concentration range of 1.0 to 10 ppm. Metals in combination were less toxic than individually. (Geiger-FRC)
W82-06436

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang.
Hydrobiologia, Vol 87, No 3, p 193-200, March, 1982. 2 Tab, 4 Fig, 19 Ref.

Descriptors: *Primary productivity, *Algae, *Sediment, *Settling basins, *Transparency, Phosphorus, Eutrophication, Water treatment, Water quality, Reservoirs, Water supply, Sewage effluent, River basin development, Silt, Reservoir operation, Lake Monroe, Indiana.

Lake Monroe is the largest body of water in Indiana. Studies were undertaken to determine the annual production rates and trophic status of the lake. The result then served as a basis for interpreting data on the subsequent nutrient enrichments. C-14 bioassays with enrichments of major and minor nutrients were conducted, and algal response to different light availability conditions was investigated. The diurnal changes in major nutrients and carbon, nitrogen, and phosphrous ratios were examined. Results indicated that phosphorus is the major limiting nutrient on algal photosynthesis in this lake. Surface photo-inhibition may be used to indicate the sufficiency of light for the species of algae in the water. The low productivity in December, January, February, and early March can be attributed to light limitation due to the low water transparency. (Titus-FRC)
W82-06470

CIRCULATION PATTERNS; THEIR INVESTIGATION AND PREDICTION,
Leicester Polytechnic (England). School of Life Sciences.
For primary bibliographic entry see Field 5F.
W82-06477

DIATOM DISTRIBUTION AND STATUS OF ORGANIC POLLUTION IN SEWAGE DRAINS,
Delhi Univ., New Delhi (India). Dept. of Botany.
K. M. M. Dakshini, and J. K. Soni.
Hydrobiologia, Vol 87, No 3, p 205-209, March, 1982. 1 Tab, 1 Fig, 14 Ref.

Descriptors: *Diatoms, *Sewage, *Nitrate, *Indicator species, *Organic wastes, Nitrogen, Water quality, Organic matter, Organic loading, Correlation analysis, Water sampling, Ammonia, Sewers, India, River Yamura.

Data on the limnology of various sewage drains discharging into the River Yamuna in Delhi, India, suggest that the diatom distribution and concentration of nitrate nitrogen vary with the degree of organic pollution. Surface water samples were collected from each drain in three different seasons throughout a one year period. The samples were analyzed for physiochemical characteristics and diatom composition. In the drains investigated, diatoms, nitrate nitrogen and dissolved oxygen were generally highest in winter, high in the post-monsoon period and low in summer. Such a uniform seasonal trend was not evident for ammonia nitrogen and chemical oxygen demand. Detailed autecological studies are required before a final relationship between diatom density and the organic content of sewage can be stated. (Titus-FRC)
W82-06484

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters, and M. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 785-790, May, 1982. 1 Fig, 3 Tab, 25 Ref.

Descriptors: *Phosphorus, *Lakes, *Regression analysis, *Particulate matter, *Seston, Nutrients, Phosphorus compounds, Phosphates, Water analysis, Surface water, Mathematical studies, Rivers, Reflectance, Lake Memphremagog, Quebec.

The amounts of colored particulate matter measured by reflectance in the surface waters of Lake Memphremagog and its tributaries were regressed against levels of total phosphorus (P), particulate P, soluble reactive P, orthophosphate, large molecular weight P (> 5000) and small molecular weight P (< 400) to see which fraction was the best predictor of seston concentration, and to determine if riverine samples differed from lake waters in the relationship between P levels and suspended particulates. Total P correlated with colored particulates better than any other fraction in both lotic and lentic environments. Regression lines describing the relations were similar in both lakes and rivers, although river samples showed greater variation than lake samples. These findings, confirm the retention of total P as the simplest and most meaningful measure of this important nutrient in both lakes and rivers. (Geiger-FRC)
W82-06496

ENVIRONMENTAL IMPROVEMENT AT PORT ALICE, B. C.,
E. V. S. Consultants, Inc. Seattle, WA.
E. M. Tokar, J. P. Campbell, and R. Tollefson.
Pulp and Paper Canada, Vol 83, No 5, p 50-53, May, 1982. 4 Fig, 2 Ref.

Descriptors: *Pulp and paper industry, *Fish, *Toxicity, Water pollution effects, Aqutic life, Salmon, Dissolved oxygen, Water quality, Benthic fauna, Pulp wastes, Port Alice, British Comumbia, Neroutsos Inlet.

Pollution control equipment (including an incineration system) installed at the Western Forest Products Ltd. pulp mill at Port Alice, British Columbia, during 1971-77, dramatically improved dissolved oxygen concentrations and suspended solids in the receiving waters. Neroutsos Inlet on Vancouver Island. Surveys during 1978-80 showed a reduction in BOD discharge from a high of 227,000 to 70,000 kg per day. Average dissolved oxygen increased from 3 to 5 ppm. Primary productivity and intertidal organism numbers and diversity decreased in waters close to the mill, but the size of the affected zone has decreased. Chum salmon appeared to avoid certain areas of the inlet near the mill. In laboratory tests the biomass of juvenile chum salmon was not affected until effluent concentrations were 0.10-0.25 of the 96 hour LC50 on a continuous basis. Nevertheless, healthy fish populations exist in the inlet, as they apparently did even during the years before pollution abatement measures were started. (Cassar-FRC)
W82-06515

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,
Maryland Univ., College Park. Dept. of Microbiology.
F. L. Singleton, R. W. Attwell, M. S. Jangi, and R. R. Colwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 1080-1085, May, 1982. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuaries, *Microbiological studies, *Water pollution effects, *Vibrio cholerae, Aquatic life, Laboratory studies, Salinity, Nutrients, *Organic matter, Decomposing organic matter.

An investigation was performed on the possibility of employing microcosms to determine the influence of selected environmental parameters on growth and survival of a toxigenic strain of Birio cholerae in the aquatic environment as a means of establishing the autochthonous estuarine source of V. cholerae. Over the range of conditions tested, this strain of V. cholerae showed maximum response, as determined by increased plate counts and direct microscopic counts in microcosms prepared with a chemically defined sea salts solution at a salinity of 25%. With lower or higher salinity levels, the maximum population size declined. When added organic concentrations of less than 1,000 micrograms/liter were present, a marked salinity effect on the growth of V. cholerae was detected. However, at or above an organic nutrient concentration of 1,000 micrograms/liter, the need for an optimum salinity level was spared. From the results of this study it was concluded that V. cholerae can grow under conditions of organic nutrient concentration and salinity typical of estuaries. Results obtained support the hypothesis that V. cholerae is an autochthonous member of the estuarine microbial community. (Baker-FRC)
W82-06534

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,
Technion--Israel Inst. of Tech., Haifa.
Y. Azov, G. Shelef, and N. Narkis.
Applied And Environmental Microbiology, Vol 43, No 2, p 491-492, February, 1982. 2 Fig, 7 Ref.

Descriptors: *Algae, *Detergents, *Oxidation ponds, Municipal wastewater, *Wastewater treatment, Algal toxins, Israel, Water pollution effects, Wastewater farming.

High-rate oxidation ponds are used in Israel to combine wastewater treatment with the production of algal biomass to be used as a protein-rich animal feed. There has been some concern regarding the inhibitory effects of anionic non-biodegradable detergents on algal growth in these oxidation ponds. This study of the effect of detergents on algal production showed that regular concentrations of hard detergents in domestic wastewater did not affect algal growth in high-rate oxidation ponds. The addition of nonionic hard detergent at concentrations exceeding 60 milligrams per liter decreased algal concentration in the batch culture. Concentrations of detergent exceeding 100 milligrams per liter had a severe effect on algal morphology, with complete lysis of the algal cells occurring within a few days. These results indicate that only a considerable increase in the use of hard nonionic detergents or feeding the pond with in-

dustrial wastewaters which contain high concentrations of hard detergents would cause a severe inhibition of algal production. (Carroll-FRC)
W82-06538

EFFECT OF SULFIDE ON NITROGEN FIXATION IN A STREAM SEDIMENT-WATER SYSTEM,
Waterloo Univ. (Ontario). Dept. of Biology.
T.-Y. Tam, C. I. Mayfield, W. E. Inniss, and R. Knowles.
Applied and Environmental Microbiology, Vol 43, No 5, p 1076-1079, May, 1982. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Nitrogen fixation, *Sediments, Streams, Chemical reactions, Sulfides, Hydrogen sulfide, Acidity, Oxidation-reduction potential, Nitrogen, Carbon dioxide, Ethylene, Anaerobic conditions, Coastal waters, Laboratory studies, Marine waters, Estuaries, *Ontario.

Nitrogen fixation in a sediment-water system was studied under anaerobic laboratory conditions. Sediment and water samples were obtained from a stream near Floradale, Ontario, Canada. The presence of Na2S at concentrations from 2 to 8 micromol/ml of stream water stimulated nitrogen fixation by the system. A twofold increase in total ethlyene produced compared with the controls was noted when the sulfide concentration was 8 micromol/ml. Na2S concentrations of 16 to 32 micromol/ml inhibited nitrogen fixation, with total inhibition occurring at 64 micromol/ml. Ethylene production was not noted in sterile controls. Carbon dioxide production was inhibited by sulfide at concentrations from 8 to 128 micromol/ml. The degree of inhibition increased as the concentration of sulfide increased, and complete inhibition of carbon dioxide production occurred at 128 micromol/ml. Titanium(III) citrate, a strong reducing agent, stimulated both nitrogen fixation and carbon dioxide production. Sulfide additions caused pH changes in the sediment, and when the sediment was adjusted and maintained at pH 7.0 all concentrations of sulfide inhibited nitrogen fixation activity. From considerations of the redox equilibria of hydrogen, hydrogen sulfide, and other sulfur species at various pH values, it appeared that hydrogen sulfide was the toxic entity and that HS(-) was less toxic. The observed stimulation of activity was apparently due to a pH change coupled with the concurrent production of HS(-) from hydrogen sulfide. (Baker-FRC)
W82-06540

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,
Windsor Univ. (Ontario). Dept. of Biology.
M. A. Holder-Franklin.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 124, 1981. 107 p 28 Fig, 40 Tab, 147 Ref.

Descriptors: *Saint John River, *Meduxnekeag River, *Dunbar River, Taxonomy, Methodology, Aquatic populations, Organisms, Sediments, Diurnal variations, Mathematical models, Pollutants, *Bacterial populations, Physico-chemical parameters, Isolates, Culturing procedures, Temperature factors, Oxygen levels, Nutrients, *New Brunswick, Maine, *Heterotrophic bacteria.

Population shifts in heterotrophic aquatic bacteria from a watershed with several months of ice cover annually and a temperature range of 0C to 28C have been studied by classical and numerical taxonomy, factor analysis and species diversity. Mathematical techniques have been utilized to demonstrate correlations between changes in the bacterial populations and certain physico-chemical environmental parameters. A complete methodology has been developed, beginning with isolation and culturing procedures and proceeding through the taxometrics to the multivariate statistics and the selection of correlation coefficients. This series of reports is a retrospective of work over a period of ten years and describes the seasonal and diurnal changes in the predominant flora in the free-flowing river and the sediment. The major environmental influences in each econiche are related to the bacterial flora. Although the bacterial population can be shown to fluctuate diurnally and seasonally, the overall predominant taxonomic groups in all locations in all seasons are the Pseudomonas, with the fluorescent group generally predominant in the winter and the non-fluorescent species prevailing during other seasons. The most important group are the gram-negative rods and of these the aerobic group dominate. The aerobes are followed by the facultative aerobes and members of the Enterobacteriaceae appear with moderate frequency in the high-profile segment of the population. The environmental parameters which have the most significant influence on the flora are the temperature; oxygen levels; the nutrients, particularly the amount and form of nitrogen; and the specific conductivity. (WATDOC)
W82-06558

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,
For primary bibliographic entry see Field 5A.
W82-06560

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,
For primary bibliographic entry see Field 5A.
W82-06562

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,
For primary bibliographic entry see Field 5A.
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06566

A REVIEW OF BENZOTHIAZOLES IN THE AQUATIC ENVIRONMENT,
Canada Centre for Inland Water, Burlington (Ontario).
B. Brownlee, J. H. Carey, and M. E. Fox.
National Water Research Institute, Scientific Series No 126, 1981. 5 p, 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Reviews, *Pollutant identification, *Benzothiazoles, Chemical properties, Biological properties, Aquatic environment, Toxicity, Water extracts, Air emissions, Waste water, Gas chromatography, Environmental contaminants.

The following aspects of benzothioazoles are reviewed: (1) physical and chemical properties, (2) analysis and occurrence, (3) biological properties and (4) mammalian toxicity and human health. Six reports were found in the literature on the occurrence of benzothioazoles in the following areas of the aquatic environment: river water (1-2ppb), drinking water, and tire plant wastewater (20-60ppb). Benzothiazoles display a wide range of biological activity and are used commercially as fungicides. No data were found for toxicity to aquatic organisms, although acute mammalian toxicity is low. Future research areas are identified, the most important of which are (1) physical properties, (2) persistence and (3) aquatic toxicity. (WATDOC)
W82-06571

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W82-06600

HYDROGEN SULFIDE CORROSION OF THE BAGHDAD TRUNK SEWERAGE SYSTEM,
M. I. Aldred, and B. G. Eagles.
Water Pollution Control, Vol 18, No 1, p 80-96, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Hydrogen sulfide, *Corrosion, *Main sewers, Sewer systems, Concretes, Baghdad, *Iraq, Middle East.

The corrosion of the trunk sewer and its main branches in Baghdad, Iraq, was investigated. The city, built on the East and West Banks of the River Tigris, is situated on a flat alluvial plain having little natural fall for drainage systems. As a result, sewage lift stations must be installed at frequent intervals. Construction on the East Bank's outfall sewer began in 1959, while the construction of the trunk sewers on the West Bank began in 1970. The main factors contributing to the production of hydrogen sulfide in the Baghdad sewerage system include the hot dry climate, low flow conditions, the high-strength sewage, the storage or retention period within the sewerage system, and poor natural ventilation of the system. Examination of the concrete sewers at about 190 manholes on the East Bank showed that all had been subject to attack by hydrogen sulfide and that the lower portions of the access ladders were surrounded with fallen pasty cementitious mass. Manhole ventilations did not appear to be related to attack by this gas. Sampling of industrial effluents entering the sewer system indicated that treatment of these effluents was generally limited to grease traps and small sedimentation tanks. Nearly all the discharges exceeded limitations on pollutants. Available methods of sulfide control include ventilation and odor control, pH control, aeration, chlorination, nitrate dosing, injection of hydrogen peroxide and oxygen, improved treatment of industrial effluents, and improved sewer maintenance. In the new system, pretreatment with hydrogen peroxide or oxygen at the pumping station should help keep sulfides low. Several recommended remedial actions are discussed. (Carroll-FRC)
W82-06651

EFFECTS OF SUSPENDED VOLCANIC SEDIMENT ON COHO AND CHINOOK SALMON IN THE TOUTLE AND COWLITZ RIVERS,
Washington Univ., Seattle. Fisheries Research Inst.
Q. J. Stober, B. D. Ross, C. L. Melby, P. A. Dinnel, and T. H. Jagielo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256801, Price codes: A09 in paper copy, A01 in microfiche. Report FRI-UW-8124, November, 1981. 146 p, 48 Fig, 25 Tab, 36 Ref, 1 Append. OWRT C-00238-V(No 1417)(1), 14-34-0001-1417.

Descriptors: *Salmon, *Bioassay, *Volcanoes, *Fallout, *Suspended sediments, Suspended solids, Water quality, Assay, Histology, Sediments, Suspended load, Biological properties, Chemical analysis, Water analysis, Gills, Fish physiology, *Washington, Cowlitz River, Toutle River.

Toleranes of Coho and Chinook salmon to suspended volcanic (Mount St. Helens) sediment were determined by live-box and static laboratory bioassays. The 96-hour LC-50 suspended sediment levels determined by live-box bioassay for presmolt and smolt Coho, and fall Chinook smolts were 1217, 509, and 488 mg/liter, respectively. Static 96-hour LC-50 values for Coho and fall Chinook smolts in mudflow sediment were 29,580 and 11,000 mg/liter. While live-box bioassays integrate numerous water quality parameters, only suspended sediment was tested. Other tests run in artificial streams (0.5-1.5 liter/sec flowrate) having known suspended sediment levels (0-16% of 96-hour LC-50 value) evaluated for sublethal effects (swim performance, seawater entry test) showed no consistant effect. Histological analysis of field/laboratory-tested salmon showed no suspended sediment effect on gill tissue. The results are compared to actual Coho presmolt mortality data following the Mount St. Helens eruption. Water quality data (e.g. trace metals) and sediment particulate size measurements are included. The volcanic ash had

particle sizes equivalent to silt-fine sand and was high in silica, magnesium, and iron. (Zielinski-MAXIMA)
W82-06706

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256819, Price codes: A02 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 81, December, 1981, Knoxville. 13 p, 1 Fig, 2 Tab, 16 Ref. OWRT A-057-TENN(1), 14-34-0001-0145.

Descriptors: *Toxins, *Water reuse, *Catfish, *Recirculated water, Fish toxins, Hazardous materials, Fish, Neutralization, Biological properties, Biochemical tests, Bioassay, Assay, Antibiotics, Proteins, Toxicity, Wastewater renovation, Water quality.

Channel catfish serum contains an immunoglobulin (IgM), 14S-macroglobulin. It was determined that the catfish immune serum could neutralize tetanus toxin (TT) at the 1.28 antitoxin units (AU/ml) level, and that catfish 14S-macroglobulin (11.3 mg/ml) from Sephadex G-200 gel filtration could neutralize TT at the 0.32 AU/ml level. The 0.01 AU/ml level of TT neutralization is considered to be the minimal level needed for protection in humans. After 2-mercaptoethanol (2ME) reduction and alkylation, no TT neutralization by the catfish immune serum or by the 14S globulin remained. The catfish 7S globulin (40 mg/ml) had no TT neutralizing ability either before/after 2ME reduction and alkylation. Decreases in 14 S and 7S globulin titers after 2ME reduction and alkylation indicated that both globulin fractions were sensitive to sulfhydryl reduction. Catfish reciprocal indirect hemaglutination titers were 2048 10 days after primary immunization and did not rise above 8192 even after 10 months post-primary immunization. Not until after the first booster dose of 0.5 ml toxoid was given at 10 months, post-primary immunization was a protective TT neutralization level (0.08 AU/ml) found, with titers still at 8192. This indicates an IgM antibody memory response for TT neutralization by the channel catfish. (Zielinski-MAXIMA)
W82-06707

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,
Oklahoma Univ., Norman. Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W82-06710

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,
State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
E. L. Rowe, R. J. Ziobro, C. J. K. Wang, and C. W. Dence.
Environmental Pollution, Series A, Vol 27, No 4, p 389-396, April, 1982. 3 Tab, 20 Ref.

Descriptors: *Bleaching wastes, *Algae, Toxicity, Chlorination, Chlorine, *Chlorophenols, *Chlorinated hydrocarbons, Aquatic plants, *Duckweed, *Bioassays, Water quality.

The toxicity of a number of compounds, primarily chlorophenols, present in spent pulp bleaching liquors was investigated toward a freshwater unicellular alga, Chlorella pyrenoidosa, and a duckweed, Lemna perpusilla. In addition to individual compounds, the effect of the whole spent chlorination and caustic extraction liquors on the alga was also determined. Test chemicals included catechol, 4,5-dichlorocatechol, 3,4,5-trichlorocatechol, tetrachlorocatechol, phenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, guaiacol, 4,5-dichloroguaiacol, 4,5,6-trichloroguaiacol, 9,10-epoxystearic acid, p-cymene, monobromo-p-cymene, and dichloro-p-cymene. The study indicated that the toxicity of the chlorine substituted compounds was greater than that of the parent compounds and that increasing numbers of chloro substituents resulted in increased toxicity. Spent chlorination liquor was more toxic to the alga than spent caustic extraction liquor. The comparatively severe toxic effects of the catechol compounds on the alga and duckweed in this study duplicate the findings of earlier studies with Daphnia. The comparatively low toxicity of epoxystearic acid toward the alga and duckweed were compatible with findings on juvenile rainbow trout, Salmo gairdneri. Both test organisms used in this study proved satisfactory for evaluating the toxicity of compounds identified in spent chlorination and caustic extraction liquors and were superior for this purpose to the fungi examined in previous studies. (Baker-FRC)
W82-06721

FURTHER OBSERVATIONS ON THE EFFECT OF ABATE ON FISH CATCHES,
Ghana Inst. of Aquatic Biology, Achimota.
E. K. Abban, and J. Samman.
Environmental Pollution, Series A, Vol 27, No 4, p 245-254, April, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Fish populations, *Larvicides, Pesticides, Rivers, Volta Basin, *Ghana, Savanna rivers, *Abate, Seasonal variations, Aquatic life, Ecosystems.

A short term evaluation was made of the effects of Abate in relation to fish and fisheries. Specifically, effects of the weekly application on fish catches during the long dry season from November to May in Northern Ghana are reported. Such dry periods are typical of the savanna regions of the Onchocerciasis Control Program (OCP) area of the World Health Organization. The study was conducted on the White Volta, a major river in the Volta Basin. The river at this time existed mainly as a series of slow flowing pools connected by relatively shallower and faster flowing sections. The study period lasted 11 days, during which time Abate was applied aerially directly to the river. Fish samples were taken about 1 km from the dosing point. In the OCP Abate is applied at a dosage rate of 0.04 ppm for each 10 minutes of river discharge. Each sample consisted of fish caught in a battery of nets in 12 hr. Following the larvicide application on 20 May, six day and six night samples were taken before the next treatment on 27 May. No fish kills were noted that could be associated with Abate treatment on the river. Fish normally avoided the larvicide by moving downstream. However, when the fishes' movements were restricted due to the low water, they did undergo stress-movements, which increased their proneness to capture in nets. It is evident that during the dry season regular treatment of rivers may expose fish to the larvicide for longer periods than expected. (Baker-FRC)
W82-06722

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,
Military Engineering Services, Hyderabad (India).
R. C. Sehgal, and Y. Jaluria.
Energy, Vol 7, No 5, p 419-428, May, 1982. 7 Fig, 17 Ref.

Descriptors: *Thermal pollution, *Flow pattern, Powerplants, Thermal powerplants, *Thermal water, Heated water, Waste heat, Temperature effects, *Model studies, Isotherms, Temperature gradients, Thermoclines.

The turbulent recirculation that occurs due to thermal discharge to a shallow water body has been studied. A horizontal, two-dimensiional model was developed to determine the nature of the flow field generated. The model assumes complete mixing in the vertical direction and steady ambient conditions. Various configurations of the intake and outfall are considered, and the intake water temperature is determined as a function of the heat rejected. It is found that the spread of the flow region is a strong function of the flow configuration and of the distance between the outfall and the intake. The intake temperature was found to be insensitive to the amount of heat rejected at low values of the rejection rate. At large values, however, a strong dependence is observed, and the intake temperature rises sharply with heat rejected. The effect of turbulent mixing in the water body due to winds, inflow, level changes and other causes is considered in terms of the eddy diffusivities, and a relatively weak dependence over the range of interest is indicated. The streamlines and isotherms under various conditions of inflow, ambient conditions and amount of heat rejected per unit area are determined. The results are compared with a simple one-dimensional model. The study indicates the water surface region over which significant transport processes occur. These results can be employed in one-dimensional vertical models to obtain the effective surface area for heat rejection, determine the stratification that results, and find the transient behavior of the water body. The results are directly applicable to shallow water bodies and to those in which good vertical mixing exists. The study provides a basis for the design of such heat rejection systems, particularly with respect to the horizontal separation of the intake and outfall. (Baker-FRC)
W82-06723

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
K. G. Wetzel.
Ambio, Vol 11, No 2/3, p 126-131, 1982. 5 Fig, 1 Tab, 8 Footnotes.

Descriptors: *Water supply, *Nuclear explosions, *Radioisotopes, *Drinking water, Disasters, Agriculture, Industrial water, Groundwater pollution, Surface water, Fate of pollutants, Radioactivity, Air pollution, Streams, Rivers, Reservoirs, Aquifers, Lakes, Public health, Toxicity, Water pollution effects, Fallout, Rain, Disasters, War.

The radioactive contamination of freshwater supplies after a global nuclear war is estimated for a lowland temperate climate. Regions exposed to local fallout would be contaminated with the persistent and toxic I-131, Sr-89, Sr-90, and Ru-106 and with other radioisotopes with shorter half-lives; regions exposed to global fallout only, with I-131. The most serious contamination would come from radioactive rain water, followed by rivers, lakes, and least affected, groundwater reservoirs. In the most severely impacted areas, rain water would be so highly loaded with I-131 that skin contact would produce visible changes to the skin within several days. Rainfall could also wash radioactive fallout into concentrated areas, enhancing radioactivity levels by 10 to 100 times. Well-mixed lakes with long residence times would dilute radioactivity better than other lakes. Stream water in direct fallout regions would exceed maximum drinking water concentrations for about 4 weeks and in global fallout regions, for 2 weeks. Groundwater would be reasonably safe for drinking except in aquifers with short residence times (a few years or less), aquifers covered by sediments low in ion exchange capacity, or soil layers less than 1 meter thick. In general groundwater contamination in directly exposed regions would have about one-tenth the radioactivity of stream water. Much worse contamination of surface water would be expected in montiform, karstic, permafrost, desert, and marshland regions. Semi-arid regions would have higher contamination than tropical regions, which would receive about half the fallout of temperate regions. The Southern Hemisphere would be less affected by a factor of 0.03. (Cassar-FRC)
W82-06733

PRODUCTION AND VERTICAL FLUX OF ATTACHED BACTERIA IN THE HUDSON RIVER OF THE NEW YORK BIGHT AS STUDIED WITH FLOATING SEDIMENT TRAPS,

Lamont-Doherty Geological Observatory, Palisades, NY.
H. W. Ducklow, D. L. Kirchman, and G. T. Rowe.
Applied and Environmental Microbiology, Vol 43, No 4, p 769-776, April, 1982. 3 fig, 5 Tab, 30 Ref.

Descriptors: *Plumes, *Bacteria, Rivers, *Hudson River, Sedimentation, Measuring instruments, Sediment sampler, Fluctuations, Diatoms, Particulates, Mineralization, Organic carbon, Organic compounds, Water temperature, Nutrients, *New York Bight.

The growth and vertical flux of attached bacteria were investigated with floating sediment traps in the Hudson River Plume of the New York Bight during the spring diatom blooms. Traps were floated at the base of the mixed layer for 1 day periods. After recovery bacterial abundance and rates of (methyl-3H)thymidine incorporation were measured in the trap samples. The vertical flux of attached bacteria was estimated with a model formulated to distinguish between bacterial accumulation in traps due to in situ growth and that due to vertical flux. The results indicated that in situ growth of bacteria in sediment traps was unimportant as a source of bacterial increase when compared with vertical flux during this study. The vertical flux of attached bacteria removed 3 to 67% of the total daily bacterial production from the water column. Particulate organic carbon was not significantly mineralized by attached bacteria during its descent to the sea floor in the plume area during this period, when water temperature and grazing rates were at their annual minima. (Baker-FRC)
W82-06736

EFFECTS OF ACID ON PLANT LITTER DECOMPOSTION IN AN ARCTIC,
Cincinnati Univ., OH., Dept. of Biological Sciences.
V. L. McKinley, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 5, p 1188-1195, May, 1982. 5 Fig, 1 Tab, 37 Ref.

Descriptors: *Decomposing organic matter, *Hydrogen ion concentration, *Lakes, Polar regions, Arctic, Arctic zone, Acid rain, Precipitation, Litter, Plants, Acidity, Microbial degradation, Aquatic plants, Toolik Lake, *Alaska, Oligotrophic lakes.

The effects of acidic pH on the microbial decomposition of plant litter were studied during the summer of 1980 in microcosms from Toolik Lake, Alaska. Toolik Lake is a large, deep water lake on the north slope of the Brooks Range of mountains within the Trans-Alaska Pipeline corridor. It is very oligotrophic and its waters have very little buffering capcaity. Microbial decompostition of Carex in response to acidification was evaluated directly by determinations of weight loss and changes in C/N rations of the litter over time. Microbial biomass and activity associated with the litter were evaluated by the measurement of adenosine triphosphatase concentrations and by determination of the rates of acetate incorporation into microbial lipids, respectively. The community structure of the microbiota on the litter surface was examined by scanning electron microscopy and the effects of acid on the mineralization of Carex lignocellulose were also examined. Microbial activities associated with Carex litter were significantly reduced within 2 days at pH values of 3.0 and 4.0, but not 5.0, 5.5, or 6.0. ATP levels were significantly reduced at pH 30., but not at the other pHs tested. After 18 days microbial activity significantly correlated with weight loss, nitrogen content, and C/N ratios of the litter but did not correlate with ATP levels. Fungi present at ambient pH did not become dominant at pH below 5.5, diatoms were absent below pH 4.0, and bacterial numbers and extracellular slime were reduced at pH 4.0 and below. It was concluded that if the pH of the water from this slightly buffered lake were sufficiently reduced, rates of litter decomposition whould be significantly reduced. (Baker-FRC)
W82-06737

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,
Univerity of West Florida, Pensacola. Dept. of Biology.
M. A. Hood, and G. E. Ness.
Applied and Environmental Microbiology, Vol 43, No 3, p 578-584, March, 1982. 9 Fig, 20 Ref.

Descriptors: *Estuaries, *Bacteria, *Escherichia coli, Estuarine environment, Coastal waters, Marine waters, *Vibrio cholerae, Coliforms, *Florida, Apalachicola Bay.

The survival of strains of Vibrio cholerae in estuarine waters was studied and compared to that Escherichia coli. Water and sediment samples were collected from Apalachicola Bay, Florida. The enviromnetal V. cholerae serotype 01 strain (WF/1) survived well in estuarine waters and sediments. The survival of WF/1 was examined in sediments and waters collected from two different sites. One site had a lower mean salinity than the site at which the organism was originally found. Although the salinities of the waters at the sites were 6 and 15% there was no significan difference in the survival of the organism. The survival of WF/1 varied with the time of the year when samples were taken. The temperature at which the survival chambers were incubated had a significant effect on organism survival. Comparison of different V. Cholerae strains revealed no significant differences in the survival of serotype 01 and non-01 isolates in sterile or nonsterile sediments or waters. E. coli ATCC 25922 did not survive well in estuarine waters and could not be recovered by plating or most probable number procedures after 7 days in nonsterile water and 14 days in sterile water. These findings may explain the recent observations that V. cholerae levels do not correlate well with fecal coliform concentrations in estuarine waters. Futhermore, the results add increasing evidence to support the theory that V. cholerae is an autochthonous bacterium in estuaries. (Baker-FRC)
W82-06742

INTERMEDIARY METABOLISM OF ORGANIC MATTER IN THE SEDIMENTS OF A EUTROPHIC LAKE,
Michigan State Univ., Hickory Corners, W. K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Applied and Environmental Microbilogy, Vol 43, No 3, p 552-560, March, 1982. 4 Fig, 5 Tab, 37 Ref.

Descriptors: *Lake sediments, *Decomposing organic matter, Organic matter, Decomposition, *Metabolism, *Eutrophication, Fatty acids, Methanogenesis, Fermentation, Anaerobic conditions, Sedments, Sedimentation, *Michigan, Wintergreen Lake.

The rates of production and fates of the fermentation intermediates were investigated in the profundal sediments of a eutrophic lake (Wintergreen Lake, Michigan) in order to identify the central intermediates in carbon metabolism. The relative importances of sulfate reduction and methanogenesis in controlling the turnover of fermentation intermediates were also examined. C-14 labeled fatty acids were directly injected into sediment subcores for turnover rate measurements. The highest rates of acetate turnover were in surface sediments of up to 2 cm depth. Methane was the dominant product of acetate metabolism at all depths. Simultaneous measurements of acetate, propionate, and lactate turnover in surface sediments gave turnover rates of 159, 20, and 3 microM/hr respectively. Inhibition of methanogenesis with chloroform resulted in an immediate accumulation of volatile fatty acids and hydrogen. Hydrogen inhibited the metabolism of C3-C5 volatile fatty acids. The rates of fatty acid production were estimated from the rates of fatty acid accumulation in the presence of chloroform or hydrogen. The mean molar rates of production were acetate, 82%; propionate, 13%; butyrates, 2%; and valerates, 3%. A working model for carbon and electron flow is presented which illustrates that fermentation and methanongenesis are the predominant steps in carbon flow and that there is a close interaction between fermentative bacteria, acetogenic hydrogen-producing bacteria, and methanogens. (Baker-FRC)
W82-06745

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,
Washington Univ., Seattle. Dept. of Microbiology and Immunology.
J. T. Staley, L. G. Lehmicke, F. E. Palmer, R. W. Peet, and R. C. Wissmar.
Applied and Environmental Microbiology, Vol 43, No 3, p 664-670, March, 1982. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Volcanoes, *Lakes, Subalpine zone, Climatic zones, *Mt St Helens, Washington, Coliforms, *Bacteria, Disasters, Bacterial analysis, Limnology.

Changes in the bacterial communities in lakes near Mt. St. Helens were studied during the summer of 1980 and the spring and summer of 1981. Four subalpine lakes that lie immediately outside the blast zone were designated as controls. All other lakes studied were in the scorched, timber blow down, debris avalanche area within the blast zone. Two new lakes (Coldwater and Castle) were formed by the debris avalanche damming tributaries of the North Fork of the Toutle River. Lakes that were severely affected by the eruption and debris avalanches had higher microscopic bacterial counts than controls. All lakes affected by the eruption yielded higher viable numbers of heterotrophic bacteria than controls. Ryan and Castle lakes, with the highest microscopic counts initially, had the lowest viable counts of all of the blast zone lakes. Vertical profiles of Sprit and Castle Lakes indicated that the bacterial numbers were quite uniform from surface to bottom. Total or fecal coliform bacteria were not found in the control lakes. In contrast, all of the blast zone lakes had detectable total coliform bacteria, and some had fecal coliform bacteria after the eruption. Coliform bacteria were more numerous than expected in blast zone lakes, but they were not the most abundant bacteria in any of the lakes. It was concluded that blast zone lakes were significantly affected by the eruption. (Baker-FRC)
W82-06746

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,
University of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06747

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,
Tokyo Univ. (Japan). Ocean Research Inst.
T. Nishio, I. Koike, and A. Hattori.
Applied and Environmental Microbiology, Vol 43, No 3, p 648-653, March, 1982. 5 Fig, 2 Tab, 12 Ref.

Descriptors: Estuarine environments, *Denitrification, *Nitrogen, *Oxygen, Coastal waters, Estuaries, Marine waters, Tokyo Bay, Bays, Tama Estuary, Odawa Bay, *Japan, *Nitrates, Bacteria, *Sediments, Sedimentation, Microorganisms.

Denitrification rates were examined in an experimental sediment-water system in which filtered seawater containing N-15-labeled nitrate flowed at a constant rate over undisturbed coastal and estuarine sediments. The rates of oxygen and nitrate consumption were determined simultaneously and were compared with the rate of denitrification. Seawater and sediment samples were collected at Tama Estuary, Odawa Bay and Tokyo Bay. The concentrations of nitrate plus nitrite in the overlying waters ranged from 17.4 to 114 microM, but those in the sedimentary pore waters were very low. The concentrations of dissolved oxygen and nitrate changed similarly over time. The concentrations of nitrite remained about the same throughout the study. Steady levels of dissolved oxygen and nitrate in the effluent were achieved

within 3 hr, and these levels were maintained for 20 to 30 hr. A later decline in dissolved oxygen and nitrate concentrations was attributed at least in part to the growth of microorganisms on the walls of the Plexiglas tubes and connecting tubes and on the bottom surfaces of the rubber stoppers. The oxygen and nitrate concentrations in the effluent actually increased when the inner surfaces of the rubber stoppers were cleaned with gauze and the connecting tubes replaced. The amounts of nitrogen evolved were found to increase initially, but after 10 hr from the onset of the study the concentration remained fairly constant. This indicates that most of the denitrification occurred near the surface of sediments, as bacterial nitrate consumption was fast, and that the concentration of evolved nitrogen in the sedimentary pore water near the sediment-water interface reached a steady level within 10 hr. (Baker-FRC)
W82-06748

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,
Freshwater Biological Association, Ambleside (England).
G. H. Hall.
Applied and Environmental Microbiology, Vol 43, No 3, p 542-547, March, 1982. 4 Fig, 2 Tab, 49 Ref.

Descriptors: *Lakes, *Nitrification, *Hypolimnion, Plankton, Metabolism, Thermal stratification, Stratification, Nitrogen, Biotransformation, Grasmere Lake, Ammonia, Nitrates, Mesotrophic lakes.

The chemical evidence for planktonic nitrification in the hypolimnion of lakes was investigated. The C-14 labeled carbon dioxide inhibitor method was tested for measuring rates of nitrification. Three distinct phases were noted in the change of dissolved inorganic nitrogen concentrations. An initial increase in ammonia concentration was followed by decreasing ammonia and increasing nitrate concentrations. The final phase was characterized by decreasing nitrate and increasing ammonia concentrations. The second phase was typical of the nitrification process. However, changes observed in inorganic nitrogen concentrations in the water column may not have been a result of in situ microbial activity, as production in and diffusion from sediments can affect the observed concentrations, particularly in the lower hypolimnion. Observations on nitrate concentration gradients between surface sediments and the water column and experiments using the nitrification inhibitor N-Serve indicated the in situ activity of chemolithotrophic nitrifying organisms. Nitrification rates were estimated throughout the period of stratification by using the N-Serve and C-14 labeled bicarbonate uptake method. Comparison of the field nitrate concentrations with the predicted nitrate concentrations from estimates of the nitrification rate indicated that the method underestimated the true rate of nitrification. (Baker-FRC)
W82-06749

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,
Wisconsin Univ., Eau Claire. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06751

EFFECTS OF POLYCHLORINATED BIPHENYLS AND ENVIRONMENTAL BIO-TRANSFORMATION PRODUCTS ON AQUATIC NITRIFICATION,
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, M. P. Shiaris, W. Beck, and S. Held.
Applied and Environmental Microbiology, Vol 43, No 4, p 949-952, April, 1982. 3 Fig, 25 Ref.

Descriptors: *Nitrification, *Polychlorinated biphenyls, Organic compounds, Chemical reactions, Water pollution effects, Microorganisms, Nitrogen, Oxidation.

The impact of polychlorinated biphenyls on autotrophic nitrification in freshwater environments was investigated. Possible biotransformation products were examined to determine whether they represent a potential nitrification perturbation. Center Hill Reservoir, a relatively pristine aquatic habitat, and Fort Loudon Reservoir, a contaminated nutrient-rich habitat, were used for studies on the effect of PCBs on nitrification. The effects observed were unclear. PCBs at concentrations greater than 10 micrograms/liter inhibited nitrification, principally ammonium oxidation, in one of the two natural reservoir environments. However, this inhibition could not be reproduced in pure high-cell-density cultures or in previously contaminated reservoir waters. The PCB environmental biotransformation product p-chlorophenylglyoxylic acid and p-chloromandelic acid had no effect on nitrification. It is noted that the studies reported here employed acute dosing conditions which ranged to concentrations that exceeded both the solubility of Aroclor 1254 (120 micrograms/liter) and concentrations likely to be encountered in the environment. It appeared that the primary target of inhibition was located at the level of the ammonium-oxidizing microorganisms. However, transient high levels of NO2(-) may accumulate due to a lesser inhibition in NO2(-) oxidation, and elevated NO2(-) concentrations may serve to further inhibit NO2(-) oxidation. (Baker-FRC)
W82-06753

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,
Rostock Univ. (Germany, D.R.).
U. Schiewer, H. A. Al-Saadi, and H. A. Hameed.
Archiv fur Hydrobiologie, Vol 93, No 2, p 158-172, January, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Tidal effects, Shatt al-Arab, Estuaries, Basrah, *Iraq, Aquatic life, Nutrients, Rivers, Water pollution effects, Canals, Tides, Tidal currents, Wastewater disposal, Raw wastewater, Wastewater, *Diel rhythm.

A short distance below the confluence of the Euphrates and the Tigris, the Shatt al-Arab receives all the untreated sewate of Basrah, a town with more than half a million inhabitants. In addition to seasonal changes in water level, the whole stretch of the Shatt al-Arab is subject to tidal influences, with the mean fluctuation in water due to tidal influences being 1.7 meters. The effect of these tidal influences on the hydrography and production biology of the Shatt al-Arab and on one of the main canals in the town of Basrah was examined in order to draw conclusions regarding the dynamics of the overall system in the upper reaches of Shatt al-Arab. The study showed that there was little sign of diel rhythms in the Shatt al-Arab, while a tide-induced diel rhythm was evident in the canal. Phytoplankton productivity of the Shatt al-Arab was low in December. Nutrient content and phytoplankton productivity in the canal were high, mainly due to fecal sewage. A cyclotella meneghiniana bloom was present during the studies. According to these findings the east shore of the Shatt al-Arab can be described as a system lying between the oligotrophic and eutrophic states. Conditions in the Al-Khandak Canal, in contrast, are allotrophic. The tides have a double beneficial effect on the Canal in that they not only flush the sewage away during the ebb, but also mix the top and middle layers of the canal water with oxygen rich water during the flood. (Baker-FRC)
W82-06763

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,
Kumaun Univ., Nainital (India). Dept. of Zoology.
A. P. Sharma, S. Jaiswal, V. Negi, and M. C. Pant.
Archiv fur Hydrobiologie, Vol 93, No 2, p 173-174, January, 1982. 4 Fig, 11 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Lakes, *Ecology, Kumaun Himalaya, Himalayas, Nainital Lake, Khurpatal Lake, Bhimtal Lake, *India, Natural waters, Nutrients, Wastewater disposal, Water pollution sources, Altitude, Elevation, Species diversity.

Information on the phytoplankton community of three representative lakes in the Kumaun Himalaya region was sought by using various coefficients commonly employed by terrestrial ecologists. The lakes studied were Nainital, Bhimtal and Khurpatal; they are situated in an area with a radius of about 20 km, taking Nainital as the center. There are 24 open drains in the catchment of Nainital, carrying household refuse, garbage, silt and unmeasured amounts of sewage and other waste products into the lake. Bhimtal is characterized by only one perennial drain carrying only a small amount of waste products and no sewage. Khurpatal has no perennial drain, but runoff water enters along all hill slopes of the watershed. Waters of Nainital have frequent blooms and subsequent collapses of green and blue-green algae, while the algal population in Khurpatal was monopolized by dinoflagellates throughout the year. Bhimtal had a representative plankton assemblage composed of green algae, diatoms and dinoflagellates. The dominance of dinoflagellates in Khurpatal can be attributed to the low levels of phosphorus present. The communities were strongly heterogeneous even on a monthly basis. Beta-diversity was higher in Lakes Nainital and Khurpatal and lower in Bhimtal, indicating that the beta-values increased with the elevation of the lakes. The dominance in Nainital and Khurpatal was centered around a few taxa, while in Bhimtal the number of dominant species was large. Nainital had low equitability and high species richness. Bhimtal had intermediate equitability and richness, and Khurpatal was poorest in species and had low equitability. (Baker-FRC)
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),
A. deInfante.
Archiv fur Hydrobiologie, Vol 93, No 2, p 194-208, January, 1982. 10 Fig, 1 Tab, 30 Ref.

Descriptors: *Zooplankton, *Seasonal variations, *Population dynamics, Aquatic life, Lake Valencia, *Venezuela, Fish populations, Rotifers, Copepods, Cladocerans, Algae, Temperature effects, Nutrients.

Duplicate samples were taken at five sites at 2 meter vertical intervals every two weeks from Lake Valencia and subjected to analysis to determine annual variations in abundance of zooplankton in the lake. The lake is warm monomictic. Phytoplankton consists of about 100 species. Blue-green algae are dominant, followed by diatoms and green algae. Zooplankton include 36 rotifer, 8 copepod and 10 cladoceran species. Two annual periods of maximal abundance of zooplankton occur: December through January and March through May. Each of these times is associated with increases in nutrients and phytoplankton in the lake. Two annual periods of minimal abundance were noted in June and November. Annual variations of the most important Copepoda, Cladocera and Rotifera species were related to variations in food availability and predators in the lake. (Baker-FRC)
W82-06765

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,
Canada Centre for Inland Water, Burlington (Ontario).
D. Liu.
Water Research, Vol 16, No 6, p 957-961, June, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Sludge disposal, Water quality, Water pollution sources, Land disposal, Wastes disposal, Wastewater disposal, Microorganisms, Leaching, Infiltration, Percolation.

This study was intended to investigate the long term effect of farmland disposal of anaerobically digested chemical sewage sludge on the microbial quality of groundwater. Sludge application rates to the lysimeters were based on total Kjeldahl nitro-

gen loading and ranged from 0 to 1500 kg TKN/ha/yr. The successive application of sewage sludge to the lysimeters from 1973 through 1976 resulted in an accumulation of high concentrations of sludges on most lysimeters except the control ones. The chemical and microbiological parameters of the three digested sewage sludges were determined. The average chemical compositions suggested that they possessed low-grade fertilizing potential for crop growth provided potassium was supplemented. Coliform baceria were a very minor group throughout the study of the total heterotrophic bacterial populations in the anaerobically digested sludges. The movements of the sludge microorganisms were followed in loamy sand and silt loam soil systems after 1-4 years of land disposal. The soils apparently had an enormous capacity to retain all microorganisms, and consequently over 90% of the surviving heterotrophic bacteria were still detained in the top 30 cm layer of both soil systems. Mass balance calculations indicated that over 95-98% of the original heterotrophic bacteria in the sludges had perished during this period of time. About three times more bacterial biomass and leachate were lost from the coarser loamy sand than from the finer silt loam after sludge application. Microbiological contamination of groundwater by the practice of sludge farmland disposal seems unlikely to occur, provided that the groundwater table is not high and the soils are not excessively wet. (Baker-FRC)
W82-06767

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,
Calgary Univ., Alberta. Dept. of Biology.
L. L. Osborne, R. W. Davies, K. R. Dixon, and R. L. Moore.
Water Research, Vol 16, No 6, p 899-902, June, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Fish, *Sediments, Rivers, Sheep River, *Alberta, Canada, *Mutagenic activity, Salmonella, Benthos, Ames test, Chlorination, Effluent, Wastewater treatment, Pollutant identification.

The purpose of this study was to determine whether increased mutagenic activity in fish and benthic sediments was developing as a result of the discharge of chlorinated sewage effluent into a section of the Sheep River, Alberta. The Ames Salmonella/ mammalian microsome assay was used to assay the mutagenic activity of the fish and sediment samples. Collection sites for the benthic sediments were from areas inside and outside of the chlorinated sewage plume. There was no indication of increased mutagenic activity in the sediments collected from within the chlorinated sewage plume, indicating that the mutagenic activity of the macroinvertebrates was not due to direct accumulation from the benthic sediment food source. One trend noted in the TA 100 results was an inverse relationship between sample volume and the number of colonies. This trend may have been a result of DMFA toxicity to bacteria, which could mask or comlicated the interpretation of dose mutagenic relationships. A significant increase in the mutagenic activity was observed in the fish samples collected from the chlorinated sewage plume. (Baker-FRC)
W82-06770

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06774

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,
West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.
D. A. Cincotta, J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 18, No 3, p 437-450, June, 1982. 14 Fig, 4 Tab, 52 Ref.

Descriptors: *Thermal water, *Fish populations, Heated water, Pulp and paper industry, Water pollution effects, Industrial wastes, *Thermal pollution, Thermal stress, *West Virginia, Codorus Creek.

Literature relating to 11 designated temperature criteria for six representative important species (RIS) was reviewed. The applicability of the Environmental Protection Agency (USEPA) water quality criteria to a nonutility thermal dishcarge was also reviewed, and an evaluation was made of the importance of behavioral data in thermal impact assessments. It was found that by applying only USEPA suggested criteria a complete and satisfactory evaluation was not obtained. Temperature behavior data, specifically preference and avoidance information, coupled with field sapling was needed to properly assess the effects of the thermal effluent. An application of this technique indicated that the thermal discharge of a paper company such as the one considered should have mninimal effects on the fish community of the stream, Codorus Creek, which receives the thermal effluent from the plant. (Baker-FRC)
W82-06777

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, R. A. Jones, and F. Y. Saleh.
Journal of Environmental Science and Health, Part B, Vol 17, No 4, p 409-437, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Pesticide residues, *Water quality standards, *Pesticides, *Water pollution effects, Agricultural chemicals, Water pollution sources, *Sediments, Bottom sediments, Rivers, Ponds, Toxicity, Bioassays, Bioaccumulation, Aquatic life, Standards, *Egypt, Regulations, Environmental effects, Particulate matter.

A recommended approach for establishing pesticide water quality standards and use regulations in Egypt is presented. The approach involves collecting and critically evaluating existing residue data; developing a monitoring program to fill data gaps; development of Egyptian water quality criteria and standards and organism tolerance levels; and comparing the critical concentration of pesticides developed for Egypt to existing concentrations. If excessive concentrations are found, then site-specific studies should be conducted to evaluate the role of soil pesticide residues in causing the excessive concentrations. Emphasis is placed in this approach on the importance of aquatic particulate matter in influencing the hazard that a specific pesticide represents to a particular beneficial use of a given aquatic system. The principles of hazard assessment are reviewed, including aquatic toxicity through organism toxicity and bioaccumulation; environmental fate; tiered testing; and the implications for pesticide use and labeling restrictions. The significance of sediments in hazard assessment is discussed, with emphasis on the presence of particulates, pesticide-particulate matter interactions, chlorinated hydrocarbon release from sediments, the effect of concentration on release from sediments, the implications of sediment concentrations of pesticides for use regulations, various bioassay techniques to determine contamination levels, the bioaccumulation of pesticides by benthic and epibethic organisms, and the use of deterministic models of pesticide behavior to determine sediment contamination probabilities. Cost effectiveness of specific hazard assessment vs. worst case regulations governing pesticide use is also considered. (Baker-FRC)
W82-06789

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W82-06790

ACID PRECIPITATION, A REVIEW,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, S. H. Kunkle, and D. R. DeWalle,.
Journal of Soil and Water Conservation, Vol 37, No 3, p 143-148, May/June, 1982. 3 Fig, 44 Ref.

Descriptors: *Acid precipitation, *Reviews, *Literature reviews, Soil properties, Acidity, Rainfall, Aquatic plants, Fish populations, Water pollution effects, Water pollution sources, Nonpoint pollution sources, Snowmelt.

The pH of rainfall under normal conditions is about 5.6. The measured pH of rain falling in the northeastern United States during the last decade averaged between 4.0 and 4.6, depending on location. The hydrogen ion concentration in precipitation today is 6 to 40 times higher than the theoretical value that would occur at the nonpolluted pH level of 5.6. Some researchers have concluded that the principal ause of higher precipitation acidity is increased fossil fuel combustion and use of taller smokestacks. A major concern is the effect of acid precipitation on aquatic ecosystems, and particularly on fish populations.Areas with poorly buffered streams and areas with crystalline or metamorphic bedrock having shallow, acid soils with a low buffering capacity are especially sensitive to acid precipitation. In some locations the snowpack appears to store the acid, releasing it during sudden thaws, and thus rapidly depressing stream pH. The potential effect of acid precipitation on trees and other vegetation is of concern as well. Long term effects of acid precipitation on the growth rates of vegetation and soil fertility are hard to ascertain and will demand long term research. Some experts in the field, however, feel that the current concern represents overreaction to the issue. (Baker-FRC)
W82-06794

FRESHWATER MACROINVERTEBRATES,
National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
M. A. Quigley.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 868-877, June, 1982. 183 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Environmental effects, *Reviews, Sediments, Macroinvertebrates, Water pollution effects, Lakes, Streams, Species composition, Indicators, Bioindicators, Organic compounds, Streamflow, Temperature effects, Turbidity, Floods, Drought, Logging, Recreation, Urban development, Thermal pollution, Aquatic habitats, Habitats, Predation, Benthic fauna, Seasonal variation, Productivity, Sampling.

The effects of pollution on freshwater macroinvertebrates were reviewed. Several books and two new journals appeared in 1981. A biotic index, a biological water quality index, an index focused on interaction of lake sediments with toxic substances, a modified Hill's ratio, and use of oligochaetes as indicator species were proposed. Case studies of pollution were described: experimental acidification, urban storm water runoff, road salt, synthetic crude oil, copper, zinc, tannery effluent, and ash. Macroinvertebrates were also affected by alteration of the physical environment of lakes and streams (temperature, stream flow and depth, turbidity, dissolved oxygen concentration, and water level fluctuations) produced by channelization, sedimentation, flash floods, drought, logging, recreational activities, thermal discharge, and urban development. Species distribution was also a function of predation, substrate, vegetation type, flow conditions, available food, water quality, and season. Production was discussed in relation to environmental factors, including trophic status. Invertebrate penetration of the sediments produced significant sediment mixing and phosphorus release. Many invertebrate sampling techniques and methods of statistical analysis were developed. (Cassar-FRC)
W82-06797

EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Research Lab. Duluth, MN.
R. L. Spehar, G. M. Christensen, C. Curtis, A. E. Lemke, and T. J. Norberg.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 877-922, June, 1982. 1 Tab, 353 Ref.

Descriptors: *Literature reviews, *Fish, *Toxicity, *Pesticides, *Reviews, *Water pollution effects, Fate of pollutants, Accumulation, Bioaccumulation, Water quality, Dissolved oxygen, Oxygen, Nitrogen, Ammonia, Acidic water, Hydrogen ion concentration, Hydrocarbons, Insecticides, Herbicides, Piscicides, Metals, Heavy metals, Industrial wastes, Effluents, Nitrites, Surfactants, Organic compounds, Chlorine, Wastewater pollution, Pulp and paper industry, Radiation, Turbidity.

A review of recent studies of effects of pollution on fresh water fish features a table summarizing the acute and chronic toxicity of about 250 inorganic and organic pollutants. The substances are listed alphabetically, followed by the fish species, Lc50 values, type of exposure, water temperature, and test conditions. The materials include insecticides, herbicides, piscicides, anesthetics, inorganic compounds and metals, organic compounds, industrial and municipal effluents, chlorine, and pulp and paper effluents. The review also describes 28 reviews and symposia on the subject. The effects of water quality (excesses and deficiencies of dissolved gases such as nitrogen, oxygen, ammonia, and HCN) and pH and acid stress are discussed. The effects of X-irradiation, nuclear waste, chronic turbidity, and reservoir discharge are also mentioned. (Cassar-FRC)
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
A. L. Buikema, Jr., E. F. Benfield, and B. R. Niederlehner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 862-868, June 1982. 83 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Reviews, *Water pollution effects, Aquatic animals, Aquatic insects, Insects, Heavy metals, Metals, Cladocerans, Zooplankton, Leachates, Surfactants, Shale oil, Amphipods, Isopods, Decapods, Mollusks, Worms, Protozoa, Pesticides, Insecticides, Organic compounds, Industrial wastes.

Recent work on the effects of pollution on invertebrates included several reviews (acid precipitation, powerplant effluents, and hazard assessment). New test methods for pesticide residues, chlorine, petroleum products, and synfuel components were described. Effects of toxic materials were discussed according to the following divisions: invertebrate communities, cladocerans, other zooplankters, amphipods, isopods, decapods, aquatic insects, mollusks, worms, and protozoa. Among the many pollutants studied were metals (Cd, Cu, Cr, Zn, and Sr), solvents, pesticides, insect growth regulators, bird control chemicals, acridine, quinoline, vinylidene chloride, coal process conversion products, phenanthrene, naphthalene, oil shale wastewater, boric acid, surfactants, chlorine, dye wastes, municipal wastewater sludges, textile mill effluents, paper mill effluents, fly ash, phenolic compounds, and thermal discharges. (Cassar-FRC)
W82-06804

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
D. J. Reish, G. G. Geesey, F. G. Wilkes, P. S. Oshida, and A. J. Mearns.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 786-812, June, 1982. 6 Tab, 392 Ref.

Descriptors: *Literature reviews, *Marine environment, *Water pollution effects, *Reviews, *Estuarine environment, Estuaries, *Pesticides, Microbiological studies, Human diseases, Waste disposal, Oil pollution, Sediments.

Recent research in the field of marine and estuaring pollution is cited in this literature review. Major areas considered included pesticides, acute effects, sublethal effects, fate, bioaccumulation, microbiology, and residues; microbiology; diseases and abnormalities; drilling fluids and muds; dredge and solids disposal; surveys; residues and related topics; oil pollution, residue analysis, residues in water and sediment, residue fate and weathering, residues in biota, dispersants, microbes, bioaccumulation, field studies, toxicity and sublethal effects and complex effluents and environments. (Baker-FRC)
W82-06808

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
J. B. Cravens.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 812-829, June, 1982. 9 Tab, 206 Ref.

Descriptors: *Literature reviews, *Thermal pollution, *Reviews, Thermal water, *Heated water, Powerplants, Thermal powerplants, *Thermal stress, Fish populations, Aquatic life, Water temperature, Temperature effects, Thermal stress, Model studies, Mathematical models, Mathematical studies, Reservoirs, Lakes, Rivers, Mediterranean Sea, Estuaries, Great Lakes, Water pollution effects.

Recent research in the area of thermal effects on water pollution are cited in this literature review. Various reviews and models were considered, including mathematical models of the temperature and time from fertilization to 50% hatch for five species of salmonid fishes, the relationship between the maximum daily food consumption and water temperature for two species, the mathematicalthermodynamic analysis of the anomalies of water, and mathematical models of the behavior and activity of thermal plumes formed when power plants discharge heated water. Site studies were performed at cooling lakes and reservoirs in various streams and rivers, at the Great Lakes, in the Mediterranean, and in various estuarine and marine systems regarding the effects of thermal plumes on aquatic life. The effects of thermal plumes on growth and reproduction of various forms of aquatic life were considered along with these effects on higher plants. Thermal effects on the reproductive cycles of adult tench Tinca tinca were presented in several studies. Thermal tolerance and temperature preference ranges were investigated fo numerous fishes and aquatic invertebrates. The interaction of temperature and other stresses was studied in aquatic flora and fauna. Biochemical reaction studies were also performed using the hermaeid ascoglossan slug Costasiella lilianae. The effect of water temperature and dissolved oxygen on the rate of biodegradation of nitrilotriacetate from samples collected from the Rur River in Belgium was studies. (Baker-FRC)
W82-06809

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 778-784, June, 1982. 3 Tab, 72 Ref.

Descriptors: *Literature reviews, *Dissolved oxygen, Reservoirs, Streams, *Reviews, Water quality, Environmental effects, Aquatic life, Fish populations, Aquatic plants Model studies, *Destratification, *aeration, Stratification.

Current literature in the field of dissolved oxygen (DO) in streams and reservoirs is reviewed. Efforts make in the area of stream standards have included a system of effluent taxes to achieve water quality standards, the concept of transferable discharge permits for BOD control, and production theory and marginal cost analyses to find the optimal combination of treatment for all wastewaters generated within an urban area. Water quality in streams and reservoirs was examined with respect to the occurrence and distribution of dissolved oxygen and organic compounds in mountain streams, the environmental impacts associated with pumped-storage hydroelectric development, and the economic value of DO levels to fishery tailwater. Aquatic effects were investigated as a function of DO, along with the effects of hypolimnetic discharges and trace minerals. Conference proceedings contained papers dealing with surface water impoundments, stormwater impact on reservoirs, and urban storm runoff. Water quality models were developed to simulate hydraulic behavior, DO, and BOD of a river network, multiple linear correlations for computing DO concentrations as a function of stream distance, differential inequality techniques to determine the upper and lower envelope of DO concentrations, river models for DO and BOD reductions to a simple function of downstream distance, and a review of the receiving-water impacts subprogram. Oxygen demand and response to waste loads were considered, along with papers dealing with reaeration and destratification as well as gas transfer and measurement. (Baker-FRC)
W82-06811

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
C. B. Murphy, Jr., and S. J. Spiegel.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 849-854, June, 1982. 84 Ref.

Descriptors: *Literature reviews, *Bioaccululation, *Heavy metals, *Reviews, Cadmium, Copper, Mercury, Lead, Zinc, Manganese, Toxicity, Fish, Aquatic plants, Aquatic life, Diatoms, Nickel, Vanadium, Iron, Mussels, Estuaries.

Current research in the field of bioaccumulation and toxicity of heavy metals and related trace elements is cited in this literature review. Specific metals investigated in various aquatic environments inluded mercury in the muscle tissue of fish from northern lakes; trace elements in tropical marine fish from Bougainville Island, Papua-New Guinea: the occurrence and distribution of zinc, copper, iron, manganese and cadmium in the water column and different parts of Tikpia fish from Lake Mariut, Egypt; and the elemental composition of aquatic plants from the Okefenokee Swamp in Georgia. Bioconcentration research touched on the copper accululation and tissue injury in the gills of the sabellid polychaete Eudistylia vancouveri, on the distribution of cadmium within captive crabs, on the concentration of V, Mn, Ni, Cu, Zn, and Cd in bay mussels, on the relation between mercury concentration and size in the mako shark Isurus oxyrhinchus, on cadmium concentrations inducing morphological changes in the diatom Tabellaria flocculosa, and on concentrations of elements in a marine food chain. Toxicity studies were conducted for cadmium, copper, other metals, synergistic and combined elements. Research was also conducted on the detoxification of heavy metals and on applications of heavy metal toxicity. (Baker-FRC)
W82-06812

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,
Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
J. K. Liou, and G. C. Van Eybergen.
Water Research, Vol 16, No 6, p 765-773, June, 1982. 13 Fig, 2 Tab, 20 Ref.

Descriptors: *Algal growth, *Model studies, Light penetration, *Light intensity, Lighting, Drinking water, Water quality.

The importance of the consideration of light adaptation and inhibition for the models for algal growth is evaluated. A model is proposed to de-

scribe the photosynthesis-light relationship, including adaptation and inhibition. By comparing time constants it was made clear that one has to seriously consider taking adaptation into account. With high measuring frequencies and especially long vertical circulation times (large mixing depths) it should be realized that this process can be important. In field situations inhibitions will not play an important role. However, for laboratory situations inhibition can have a considerable effect on the photosynthetic production. The model as presented compared with experimental results given in the literature. The results of comparison seemed satisfactory, but further experimental work is needed. (Baker-FRC)
W82-06827

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06829

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
York Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-06832

METHANE FLUX IN THE GREAT DISMAL SWAMP,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2H.
W82-06840

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,
Hawaii Inst. of Marine Biology, Honolulu.
For primary bibliographic entry see Field 5G.
W82-06846

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson, J. Turner, and J. M. Kelly.
Water Resources Research, Vol 18, No 3, p 449-461, June, 1982. 1 Fig, 4 Tab, 123 Ref.

Descriptors: *Acid rain, *Reviews, Acidity, Air pollution, Fallout, Rainfall, *Forest management, Leaching, *Litter, Organic matter, *Decomposing organic matter, Adsorption, Soil properties, *Nutrient cycling.

A review was conducted of actual and potential effects of acid rain on forest nutrient status, using the conceptual nutrient cycling model as a guideline. The effects of acid rain on the processes of gaseous output, root turnover, leaching, uptake, litterfall, streamflow, crownwash, runoff, redistribution, and decomposition are considered, as well as the effects of all these processes on the composition of water entering and leaving the forest ecosystem. Acid rain appears to be a global phenomenon, with areas downwind from major centers of fossil fuel combustion being especially affected. Changes in precipitation quality are well documented in the northeastern US, Norway, Sweden, and northern Germany, along with other locations in both the northern and southern hemispheres. Forests growing in areas currently experiencing elevated rainfall acidity are generally on sites which are relatively infertile for one reason or another. The input by hydrogen ions along with other elements in rainfall is further compounded by washoff of materials deposited on plant surfaces due to the atmospheric stripping action of forest canopy. The implications of acid rainfall must be assessed on a total ecosystem basis, and the specific processes isolated and quantified. It is noted that the impacts on a given site can be positive, negative, or both, in the sense of counteracting influences. Consequently the conduct of management practices will need to be keyed to the particular situation to treat certain inputs as assets while minimizing or reducing the impacts of detrimental substances. (Baker-FRC)
W82-06860

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,
California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5D.
W82-06870

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,
Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5B.
W82-06871

PHYSICAL PROCESS AND EUTROPHICATION,
Windsor Univ. (Ontario). Dept. of Biology.
G. D. Haffner, D. J. Poulton, and B. Kohli.
Water Resources Bulletin, Vol 18, No 3, p 457-464, June, 1982. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Harbors, *Eutrophication, Retention, Physical properties, Retention time, Phytoplankton, Lakes, Nearshore processes, Oscillations, Nutrients, Currents, *Lake Ontario, Great Lakes.

Two considerably different physical regimes of culturally enriched water bodies were compared. Biological responses to physical-chemical processes were examined in Toronto and Hamilton Harbors of Lake Ontario. Nutrient loadings of both harbors are large and of similar magnitudes, yet the trophic conditions are different. Lake oscillations apparently determined the flushing rates and environmental stability of the harbors. Low residence times (less than 10 days) resulted in homogeneous chemical conditions in Toronto Harbor, preventing the establishment of large phytoplankton crops. The longer retention time found in Hamilton Harbor permitted larger phytoplankton crops to become established. A critical retention time probably exists where nutrient input events persist for a sufficient period of time for the algal community to adapt to and exploit the environmental conditions of nearshore areas. These findings suggest that steady state theory must be applied carefully to the Great Lakes Nearshore zone. Models using steady state conditions to predict response of the system to nutrient controls should be viewed with great caution. The effects of physical processes on eutrophication must be considered. It is apparent that in neither harbor examined would the traditional expectations of nutrient control programs be realized due to the physical processes inherent to nearshore zones of large lakes. (Baker-FRC)
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,
Lund Univ. (Sweden). Inst. of Limnology.
G. Cronberg.
Archiv fur Hydrobiologie, Supplement 60, No 4, p 500-507, February, 1982. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Lake sediments, *Algae, Algal growth, Sediments, Lakes, Eutrophication, Nutrients, Oligotrophic lakes, Trophic level, Indicators, Bioindicators, *Sweden, Lake Vaxjosjon, Wastewater, disposal, Industrial wastes.

Lake Vaxjosjon is situated in the town of Vaxjo, south central Sweden, downstream from the restored Lake Trummen. The number and species of Pediastrum and Scenedesmus present in the lake were studied in a sediment core covering the period 1200 to 1970 A.D.. In recent times the lake was utilized as a recipient for sewage and industrial waste water from the town. The pollution was maintained at a high level from 1880-1930, when diversion of sewage started. During the worst pollution period a black anaerobic gyttja developed. The overall study demonstrated that the occurrence of Pediastrum and Scenedesmus species is of a complex nature, increasing in number when the nutrient concentration increases, changing in species composition in connection with eutrophication or oligotrophication processes, and developing (Pediastrum) in dependence on the macrophyte vegetation. Eutrophication first stimulates the macrophytes, and then both eutrophication and this macrophyte substrate act together to stimulate an increase in chlorococcal density. The Pediastrum species can be used as indicators of lake trophic status and history. (Baker-FRC)
W82-06878

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,
Academy of Natural Sciences of Philaelphia, PA.
J. W. Sherman, and R. Patrick.
Archiv fur Hydrobiologie, Vol 92, No 2, p 199-221, September, 1981. 9 Fig, 11 Ref.

Descriptors: *Paleolimnology, *Radioactive dating, *Cores, *Diatoms, Lakes, Limnology, Morphology, Aquatic life, Nutrients, Taxonomy, Stratigraphy, Lake Huleh, *Israel, Population dynamics, Oligotrophy, Mesotrophy.

The diatom stratigraphy of a 54-meter core taken from Lake Huleh, Israel was examined. The analysis of 500 specimen counts from each of 43 samples studied in this core indicated various historical changes in the condition of the water in the lake over the past 32,000 years. There is evidence that considerable reworking of sediments has occurred in certain horizons of the core, as evidenced by a high proportion of broken valves. In the early horizons of the profile the lake was shallow and somewhat swampy, with aquatic plants being fairly common. Toward the end of this period the lake deepened, and a well-formed deep lake existed for a period of time. During this deep stage the flora decreased greatly as the lake moved into a time of somewhat shallower, warmer and more eutrophic conditions. Later a swamplike condition occurred again in the lake, but there was still some open water areas that supported a plankton flora. The diatoms indicated that calcium was richer in this period than others and that the lake was somewhat warmer. Oligotrophic to mesotrophic conditions existed through most of the horizons except for one period when the nutrient levels may have been higher. (Baker-FRC)
W82-06880

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,
Pittsburgh Univ., PA. Dept. of Microbiology.
R. B. Yee, and R. M. Wadowsky.
Applied and Environmental Microbiology, Vol 43, No 6, p 1330-1334, June, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Bacteria, Plumbing, *Heated water, Hospitals, Legionella pneumophila, Incubation, Cooling water, Fate of pollutants, Public health, Human diseases.

Legionella pneumophila, obtained from a hospital shower head and from tap water in a surgical intensive care unit in another hospital, multiplied in unsterilized tap water at 25, 37, and 37 C for the length of the 35 day experiment. At 42 C L. pneumophila in the shower head sample began to die off after 17 days, but those in the intensive care unit samples continued to multiply for 35 days. Non-L. pneumophila bacteria increased in number for 2 days at 25, 32, and 37 C, then remained relatively constant for 35 days. At 42 and 45 C the shower head non-L. pneumophila bacteria decreased over 2 days to 100 CFU or less per ml.The intensive care unit non-L. pneumophila bacteria at 45 C incubation decreased to zero by the 14th day; at 42 C they multiplied as at the lower temperatures. These differences were caused by the different bacterial populations from the two sources. L.

pneumophila taken from the bottom of a hot water tank also multiplied when cultured at 37 C. These results indicate that L. pneumophila may multiply in warm water environments such as hot water plumbing fixtures, hot water tanks, and cooling towers. (Cassar-FRC)
W82-06881

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,
Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
Z. H. Hammad, and H. A. Dirar.
Applied and Environmental Microbiology, Vol 43, No 6, p 1238-1243, June, 1982. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Bacteria, *Water quality, *Drinking water, Microbiological studies, Khartoum, *Sudan, Water supply, Coliforms, Zeers, Sebeel water, Developing countries, Pollutant identification, Fate of pollutants, Seasonal variation, Public health.

Sebeels are watering stands, consisting of 1 or more 30-40 liter baked clay jars (zeers), which provide cool drinking water throughout Khartoum and other communities in the Sudan. A microbiological examination of sebeel water (51 samples from streets, 15 from mosques, 10 from homes, and 7 from schools) showed that coliforms, fecal coliforms, and fecal streptococci were present in 100%, 69.88% and 91.56% of the samples, respectively. Predominant bacterial genera were Staphylococcus, Aerococcus, Micrococcus, Streptococcus, Bacillus, Listeria, Lactobacillus, and Arthrobacter. Colony counts were on the order of 100,000 cells per ml and were higher in school and street samples than in mosque and home samples. However, counts of coliforms were much higher for home sebeels than for the other types, probably a result of children's poor hygiene habits. There was no relationship between total colony count and fecal contamination. Total colony counts did not vary with the season, but total coliforms and fecal bacterial counts were much higher in summer than in winter, due to increased human use and increased bacterial regrowth in the warmer water. Likewise, fecal coliforms counts were much higher during dust storms than when dust was not blowing. Three types of zeer construction were evaluated with respect to water quality. After a month there was no fecal contamination in a zeer fitted with a faucet and firmly fitted lid. Within 2 days the other two types of zeers (movable lid with no faucet and movable lid with faucet) were contaminated. (Cassar-FRC)
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
For primary bibliographic entry see Field 5A.
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,
Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06885

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W82-06887

COMPARATIVE ASPECTS OF SULFUR MINERALIZATION IN SEDIMENTS OF A EUTROPHIC LAKE BASIN,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. M. King, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1406-1412, June, 1982. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Sulfur cycle, *Mineralization, Sediments, Sulfates, Sulfides, Organic sulfur compounds, *Lake sediments, Eutrophic lakes, Wintergreen Lake, *Michigan, Proteins.

Mineralization of organic sulfur compounds in the surface sediments of eutrophic Lake Wintergreen, Michigan, was estimated from a mass balance budget of S inputs and sediment S concentrations. Net mineralization was < 50% complete. Total S mineralization was 45% complete; ester sulfate S, 42% complete; and protein S, 75% complete. Therefore organic S accumulates in the sediment. Organic S comprosed > 80% of the total S in the sediment. Of the organic S fraction protein S was < 20%; ester sulfate, 44%; and nonprotein carbon bonded S (sulfolipids, vitamins, etc), 36%. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction rates averaged 7 nmol per sq m per day, 19-fold greater than net rates or organic S mineralization and 65-fold greater than sulfate ester hydrolysis, on an annual basis. (Cassar-FRC)
W82-06888

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and D. G. Redalje.
Marine Environmental Research, Vol 6, No 4 p 265-279, 1982. 4 Fig, 4 Tab, 39 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, *Kaneohe Bay, Hawaii, Diversion, Nutrient cycling, Phytoplankton, Nitrogen, Phosphorus, Benthos, Biomass, Water pollution effects, Growth rates, Subtropical regions, Bays, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Corals, Reefs.

Dissolved organic nitrogen and dissolved organic phosphorus concentrations in the water column were much higher than expected after diversion of secondary treated sewage from Kaneohe Bay, Hawaii, to the ocean. This was caused by decomposition of 400 tons of benthic organisms during the first year after diversion. Nitrogen was the limiting nutrient before and after diversion. Internal nutrient cycling accounted for 70-90% of the phytoplankton nutrient uptake. The biomass and growth rate of the phytoplankton declined after sewage diversion, from 37% to 28% of the maximum growth rate of 1.5 fold per day. The adverse effects of the sewage discharge on the coral community were mainly caused by increases in competing benthic macrophytes and elevated plankton concentrations, which attenuated light and stimulated growth of filter feeders. Although the inorganic nutrient levels returned to presewage levels within a year after diversion, the benthic community had not yet reached an equilibrium. (Cassar-FRC)
W82-06892

EFFECTS OF MACROALGAL MATS ON THE ECOLOGY OF INTERTIDAL,
Southern Water Authority, Otterbourne (England).
P. G. Soulsby, D. Lowthion, and M. Houston.
Marine Pollution Bulletin, Vol 13, No 5, p 162-166, May, 1982. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Invertebrates, *Algae, *Intertidal areas, Mud flats, Biomass, Water pollution effects, Langstone Harbor, *England, Species diversity, Aquatic habitats, Polychaetes, Snails, Birds.

The biomass and distribution of the invertebrate fauna in intertidal mudflats, covered with algae and unaffected by algae, were sampled on several occasions in 1977-78 at several sites in Langstone Harbor, south England. This study was part of investigations on the effects of discharging sewage effluents into the harbor. Algal-covered mud had higher invertebrate biomass than uncovered mud. Mean total invertebrate biomass values in autumn samples were 40-42 g per sq m dry weight in muds with > 75% algal mat cover and 12-14 g per sq m dry weight in muds with < 25% algal mat cover. Invertebrate biomasses under algal mats were lowest in January and highest in early fall. The dominant invertebrate was a snail, Hydrobia ulvae. The Shannon-Werner species diversity index showed very little difference between sites, but a log normal plot showed slight stress in the high-algal cover communities. The opportunistic polychaete, Streblospio shrubsoli, was significantly decreased in number at the high algal cover sites. The effects of algal mat cover on the aquatic bird population were discussed, using data from previous studies. It was concluded that algal mat, although perhaps undesirable, would have little effect on the bird population. (Cassar-FRC)
W82-06893

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),
University Coll. of Wales, Aberystwyth. Dept. of Zoology.
R. D. G. Hanlon.
Hydrobiologia, Vol 88, No 3, p 281-288, May, 1982. 3 Fig, 2 Tab, 28 Ref.

Descriptors: *Litter, *Decomposition, *Energy conversion, Invertebrates, Oligotrophic lakes, Lakes, Llyn Frongoch, *Wales, Leaves, Aquatic plants, Macrophytes, Nutrients, Organic matter.

The breakdown and decomposition of leaf litter from two deciduous trees and from two species of aquatic macrophytes were investigated in an oligotrophic lake, Llyn Frongoch, Wales. During the one year's submergence in the lake, starting in November, the litter in coarse mesh bags decomposed more rapidly than litter in fine mesh bags. This was probably a result, not of invertebrate feeding, but of loss of leaf fragments through the coarse mesh. The fastest decaying litter was Isoetes lacustris L., followed by the other aquatic macrophyte, Potamogeton perfoliatus L., and the two deciduous leaf litters, Salix veminalis L. (common osier) and Fagus sylvatica L. (beech). Litter degenerated rapidly for the first month or two of leaching, then more slowly as a result of low temperature and low nutrient concentrations in the lake water. Only Isoetes in coarse bags degenerated totally before the beginning of the next year's leaf deposition, suggesting that this lake is accumulating organic matter. (Cassar-FRC)
W82-06895

COMMUNITY PHOTOSYNTHESIS AND RESPIRATION IN EXPERIMENTAL STREAMS,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
S. P. Sheldon, and M. K. Taylor.
Hydrobiologia, Vol 87, No 1, p 3-10, February, 1982. 4 Tab, 38 Ref.

Descriptors: *Photosynthesis, *Respiration, *Aquatic plants, Streams, Oxygen, Benthos, Macrophytes, Phytoplankton, Algae, Productivity, Open channels, Riffles, Epiphytes, Lotic environment.

Monticello experimental riffle-pool, open canopy, constant-flow channels were used to estimate changes in relative contributions to total stream photosynthetic and respiratory rates by various components of a stream community (plankton, benthos, macrophytes, and epiphytes). Macrophytes quickly became established in the pools during early spring. This produced self-shading, little growth during summer, and a die-back to the rhizomes in the fall. In the macrophyte-epiphyte

community (pool) photosynthesis rates (g oxygen per sq m per day) were 29.26 on June 13, 4.12-7.67 during the summer, and 0.14 on October 6; respiration rates (g oxygen per sq m per day) were 13.11 on June 13, 9-11 during the summer, and 0.77 on October 6. Riffles were colonized by benthic algal mats, established early in the spring. Photosynthesis rates (g oxygen per sq m per day) in the riffle benthos were 3.32 on June 13 and 8-11 during the summer, declining to 0.80 by October 6; respiration rates (g oxygen per sq m per day) were 11.87 on June 13, 8-11 during the summer and 1.57 on October 6. Planktonic photosynthesis and respiration were very low (maximum 1.5 g oxygen per sq m per day) in both pools and riffles. The pools were autotropic in spring, changing to heterotrophic by fall; the benthos, initially heterotrophic, became autotrophic after algal mat establishment and remained so until the fall. (Cassar-FRC)
W82-06896

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,
Alberta Univ., Edmonton. Dept. of Botany.
M. Hickman.
Hydrobiologia, Vol 87, No 1, p 21-32, February, 1982. 6 Fig, 5 Tab, 35 Ref.

Descriptors: *Thermal pollution, *Algae, *Lakes, Water pollution effects, Heated water, Power plants, Ephiphytes, Lake Wabamun, *Alberta, Standing crops, Species composition.

The effects of eliminating a powerplant heated water discharge on epiphytic algae in Lake Wabamun, Alberta, were documented from 1975 to 1978. Average surface water temperatures during the time of thermal pollution were 14-19 C warmer than ambient lake temperatures in winter and 8-9 C warmer in summer in the eastern part of the lake. Flow stopped on December 13, 1975. Peak seasonal standing crops were 209.6 mg per sq m chlorophyll a in 1971-72, 1491.7 mg per sq m in 1976, 469.0 mg per sq m in 1977, and 974.9 mg per sq m in 1978. Cocconeis placentula and Cladophora glomerata, dominant during the period of heated discharge, continued their dominance after 1975, but with greatly reduced population sizes. Oedogonium sp., Spirogyra sp., Stigeoclonium tenue, and Achnanthes minutissima decreased in sumbers. After 1975 the following species increased in importance: Epithema turgida, Rivularia haematities, Scytonema alatum, Mougeotia sp., Amphipleura pellucida, Nitzschia fonticola, Rhopalodia gibba, and Phormidium sp. (Cassar-FRC)
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,
Savannah River Ecology Lab., Aiken, SC.
J. H. Thorp, and M. R. Diggins.
Hydrobiologia, Vol 87, No 1, p 33-34, February, 1982. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Thermal pollution, *Cooling ponds, *Benthic fauna, Water pollution effects, Savannah River, *South Carolina, Nuclear powerplants, Insects, Aquatic insects, Midges, Dragonflies, Damselflies, Caddishflies, Mayflies, Invertebrates, Macroinvertebrates, Reservoirs, Species composition, Water depth.

The distribution and abundance of benthic macroinvertebrates were studies in Par Pond, a 1160 ha cooling reservoir located at the Savannah River nuclear plant, South Carolina. Sediment samples were taken at 10 water depths from 0.16 to 5 m during January-April 1978 at two sites: (A) intermittently heated by thermal discharges and (B) at ambient temperatures. The relationship between abundance of organisms and water depth was more complex than the inverse relationship generally reported in the literature. Generally, odonates occurred at depths < 1 m and were more abundant at Site B. Of the dipterans, Ceratopogonidae (biting midges) had the most even distribution with depth, Chironomids (true midges) were found mostly at 1-3 m depths, and chaoborus (phantom midges) were usually in deeper water. Diptera abundances were similar at both stations, but earlier hatching occurred at Station A. The abundance of Caenis (a mayfly) and Trichoptera did not vary significantly with depth. Caenis was far more abundant at Station A, and Trichoptera was more abundant at Station B. Size was not a significant function of depth or sampling location for most genera of Odonata and Trichoptera. (Cassar-FRC)
W82-06899

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,
Tokyo Metropolitan Univ., (Japan). Dept. of Biology.
H. Kunii, and K. Maeda.
Hydrobiologia, Vol 87, No 45-55, February, 1982. 5 Fig, 3 Tab, 33 Ref.

Descriptors: *Seasonal variation, Water quality, *Aquatic plants, Ponds, Lakes, Eutrophic lakes, Ojaga-ike, *Japan, Dissolved oxygen, Plant populations, Population dynamics, Macrophytes.

Seasonal and long-term changes in aquatic plants were studied in Ojaga-ike, a shallow eutrophic pond near Tokyo, Japan. Part of a continuing study started in 1971, this paper reports results of 1978 observations. Five species of the 10 floating-leaved and submerged plants in the pond showed changes in surface cover during the year. Potamogeton crispus and Elodea nuttallii occupied 53-5% of the total pond surface in May; Trapa natans and Nelumbo nucifera, 79.1% in July; N. nucifera and Hydrilla verticillata, 62.0% in September; and N. nucifera, 41.2% in November. The plant population and water quality were strongly related during the summer. The aquatic plants produced high dissolved oxygen concentrations in the surface water, while decomposition of plant materials caused oxygen depletion near the bottom. This condition caused an unfavorable encironment for some plants, including Charophyceae. Long-term changes were observed since 1971. Nymphyoides, Myriophyllum, and Hydrilla have been decreasing in number and range, whereas two newly established plants, Nelumbo and Elodea, have become dominant. These changes were probably a result of light completion and drying of exposed tubers during water level lowering in winter. The present order of plant dominance is Nelumbo > Trapa > Elodea = Myriophyllum > Vallisneria > Najas. It is expected that the pond will become monotypic, with Nelumbo being the main species. (Cassar-FRC)
W82-06900

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,
Florida University, Gainesville School of Forest Resources and Conservation.
D. E. Canfield, J. R. Jones, and R. W. Bachmann.
OWRT A-063-IA, Hydrobiologia, Vol 87, No 1, p 65-76, February, 1982. 2 Fig, 8 Tab, 44 Ref.

Descriptors: *Phosphorus removal, *Eutrophic lakes, *Sedimentation rates, Fate of pollutants, *Iowa, *Lake sediments, Trophic level, Seasonal variation, Chemistry of precipitation.

Mean phosphorus sedimentation rates, as determined by sediment traps, were 13.3 to 218 mg per sq m per day in four natural and four artificial Iowa lakes. Although P sedimentation rates for the natural lakes as a group were not significantly different from rates for artificial lakes, there were significant differences in P sedimentation rates for individual lakes, at different locations within a lake, at different depths within a location, and during different seasons. However, P sedimentation rates were strongly correlated with inorganic sediment concentrations and inorgaic matter sedimentation rates. The trophic status of the lakes as measured by chlorophyll a concentrations was also a function of P sedimentation rate. For example, a lake with mean P sedimentation rate of 13.3 mg per sq m per day had a chlorophyll a concentration rate of 4.0 mg per cu m; a lake with a 218.1 mg per sq m per day P sedimentation rate had a chlorophyll a concentration of 81.0 mg per cu m. Sedimentation traps did not measure net sedimentation rates, and should not be used unless resuspension and resedimentation of bottom sediments are minimal. (Cassar-FRC)
W82-06901

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,
Michigan University, Ann Arbor. Great Lakes Research Division.
For primary bibliographic entry see Field 5A.
W82-06902

MODIFICATION OF BENTHIC INSECT COMMUNITIES IN POLLUTED STREAMS: COMBINED EFFECTS OF SEDIMENTATION AND NUTRIENT ENRICHMENT,
Wake Forest University, Winston-Salem, North Carolina, Department of Biology.
A. D. Lemly.
Hydrobiologia, Vol 87, No 3, p 229-245, March, 1982. 7 Fig, 10 Tab, 59 Ref.

Descriptors: *Benthic fauna, *Silting, *Nutrients, Water pollution effects, Aquatic habitats, Habitats, Awuatic insects, Insects, Acidic water, Species diversity, Turbidity, Suspended solids, Plecoptera, Diptera, Synergistic effects, Sedimentation, Nitrates, Phosphates, Bacteria, Sphaerotilus natans, Biomass, Streams, Cullowhee Creek, *North Carolina, Caddisflies, Filamentous bacteria.

Water quality, substrate composition, and benthic insect populations were monitored in three zones of Cullowhee Creek, located in the Applachian mountains of North Carolina, over an 8-month period. Zone 1 had no sediment or nutrient enrichment; Zone 2, sediment only; Zone 3, sediment and nutrient enrichment with low levels of livestock pasture runoff. Water in the two zones receiving sediment had high turbidities, suspended solids, and bed load; minimum dissolved oxygen levels of 7.6 mg per liter; and pH, 6.6; the maximum substrate temperature was 19 C in August. Water in Zone 3, receiving livestock runoff, had higher nutrient levels, 0.076-0.140 mg per liter phosphate and 0.93-1.41 mg per liter nitrate. The species richness, diversity, and total biomass of filter feeding Trichoptera and Diptera, predaceous Plecoptera, and certain Ephemeroptera were significantly reduced in sediment-polluted zones. The primary factors affecting the filter feeders were filling of interstitial spaces in the substrate and deposition of sediment on insect body surfaces and respiratory structures. The nutrients promoted growth of the filamentous bacteria, Sphaerotilus natans, on the insects and on the surfaces of stones. This growth, combined with the fine sediments, contributed to the smothering effect. The accumulation of sediment and S. natans in gill structures was shown in several photographs. The acid sensitive species, Plecoptera and Ephemeroptera, were also affected by the depressed pH at the substrate in streams with already acid waters. Synergism of sediment and nutrient-promoted bacterial growth eliminated a significantly greater number of taxa than one pollutant alone. (Cassar-FRC)
W82-06903

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS).
Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.

For primary bibliographic entry see Field 5B.
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,
Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
For primary bibliographic entry see Field 5B.
W82-06905

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,
Maryland Univ., College Park. Dept. of Zoology.
G. A. Wyngaard, J. L. Elmore, and B. C. Cowell.
Hydrobiologia, Vol 89, No 1, p 39-48, April, 1982. 4 Fig, 35 Ref.

Descriptors: *Seasonal variation, *Population dynamics, Zooplankton, *Copepods, *Mesocyclops edax, Chlorophyll a, Eutrophic lakes, Lakes, Subtropic zone, Lake Thonotosassa, *Florida, Growth rates.

The zooplankton community of eutrophic Lake Thonotosassa, Florida, (345 ha, 2.5 km long, 1.5 km wide, mean depth 3.5 m) was studied from July 1976 to June 1977. The numerically dominant crustacean, Mesocyclops edax, had a stationary age distribution from July to March. The per capita growth rate was near zero through most of the year, showing an equilibrium between birth and death rates. In spring and summer death rates were higher, a result of predation by Diaptomus dorsalis, rotifers, and fish. In contrast to M. edax, other plankton (rotifers, D. dorsalis), chlorophyll a, and temperature showed marked seasonal variations. Zooplankton species composition was low and cladocerans were scarce compared with temperate lakes. (Cassar-FRC)
W82-06906

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,
Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, J. B. W. Wanders, and J. R. Moed.
Hydrobiologia, Vol 88, No 3, p 233-244, May, 1982. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Chelation, *Bioassay, Phosphorus, Nitrogen, Silicon, Copper, Algae, Growth rates, Heavy metals, Metals, Humic acids, Fulvic acids, Oscillatoria, Iron, Tjeukemeer, *The Netherlands, Toxicity, Water pollution effects.

The multiple addition bioassay technique, using phytoplankton populations present in the test water, was applied to water from eutrophic Lake Tjeukemeer, the Netherlands. This shallow water body, used for water level regulation, has transparent, chloride-rich water in summer and brown, nutrient-rich humic water in winter. Nitrogen, not phosphorus, was the principal factor limiting algal growth during May-November, 1979, a period in which Oscillatoria agardhii was dominant. On some sampling dates P was the second most important limiting nutrient. Omitting chelated Fe (Fe-ethylenediamine tetraacetic acid) from the algal cultures was growth limiting during periods of low dissolved Fe concentrations in the water. However, omitting inorganic Fe increased growth. The presence of the chelating agent may have affected growth by detoxifying toxic metals. Omitting the trace elements B, Co, Cu, Mn, Mo, and Zn during the summer and fall season also promoted algal growth. Although the natural Cu levels in the water were not determined, it is suspected that these have reached toxic levels in Tjeukemeer. The results of this study suggest that trace metals inhibit growth when the lake contains humus-poor water with low metal binding capacity. (Cassar-FRC)
W82-06907

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,
Hong Kong Univ., Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-06908

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,
Freshwater Fisheries Lab.
R. Harriman, and B. R. S. Morrison.
Hydrobiologia, Vol 88, No 3, p 251-263, May, 1982. 4 Fig, 6 Tab, 54 Ref.

Descriptors: *Forest watersheds, *Acid rain, *Streams, Watersheds, Salmon, Trout, Fish, Mayflies, Invertebrates, Acid streams, Acidic soils, *Scotland, Water pollution effects, Spruce trees, Trees, Fish eggs, Air pollution, Water quality.

Precipitation, water, invertebrates, and fish were studied in 12 streams flowing through forested and non-forested catchments west of Aberfoyle, Scotland. Bedrock in this region is predominantly quartzite, schists, and slates with little buffering capacity. Precipitation has an annual mean pH of 4.2-4.5. The most common tree species is Sitka spruce (Picea sitchensis Carriere). Forest streams were more acid than adjacent moorland streams (mature forest, 4.16-4.75; young forest, 4.83-5.25; and moorland, 4.90-5.80). Concentrations of aluminum were also higher in old forested streams (100-350 micrograms per liter) than in young forest and moorland streams ((< 100 micrograms per liter). Manganese concentrations were 90 micrograms per liter in forest streams and 30 micrograms per liter in non-forested streams. Among the mature forest streams only one had brown trout (Salmo trutta L.); all non-forested streams had trout. Planted salmon eggs (Salmo salar L.) died within a few weeks in forested streams but survived in non-forested streams. The only mayfly nymph found in acid streams during summer was Siphlonurus lacustris Eaton. In winter samples mayfly nymphs, Heptagenia lateralis Curtis, were found in one forest stream, but several species were present in non-forested streams. Data suggest that spruce forests collect acid pollutants and denude the soil of neutralizing elements, producing higher acidity in streams draining forested catchments. (Cassar-FRC)
W82-06909

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,
Maine Cooperative Fishery Research Unit, Orono.
J. R. Moring.
Hydrobiologia, Vol 88, No 3, p 295-298, May, 1982. 1 Fig, 30 Ref.

Descriptors: *Permeability, *Streambeds, *Logging, Gravel, Fish eggs, Clear-Cutting, Forest watersheds, Water pollution effects, *Oregon, Sediment, Hatching, Salmon, Trout, Tributary streams.

Three second-order tributary streams of the Alsea River, Oregon, were studied from 1962 to 1973 to determine the effects of logging on stream gravel permeability. Needle Branch drainage basin was 82% clear-cut, Deer Creek was 25% clear-cut with 30 m wide uncut buffer strips along the stream banks, and Flynn Creek, the control, was uncut. Road construction was completed in 1965, and logging was finished by 1967. The average gravel permeabilities decreased significantly in the clear-cut basin, from about 4900 cm per hour prelogging to 1100 cm per hour the first year after logging, increasing to 2400 cm per hour for the next 6 years. In the control and partially cut basins gravel permeabilities were not significantly different throughout the study. Monitoring gravel permeability may be more useful than determination of sediment fines in assessing the suitability of gravel conditions for salmonid eggs and alevins. (Cassar-FRC)
W82-06910

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,
Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
A. D. Lemly, and J. F. Dimmick.
Hydrobiologia, Vol 88, No 3, p 299-307, May, 1982. 3 Fig, 2 Tab, 53 Ref.

Descriptors: *Species composition, *Zooplankton, *Littoral zone, Population dynamics, Lakes, *North Carolina, Eutrophic lakes, Oligotrophic lakes Predation, Invertebrates, Seasonal variation, Cladocera, Copepods, Rotifers, Ostracoda, Cyclops.

Species composition and seasonal dynamics of zooplankton in the littoral zone of three North Carolina lakes were studied from October 1978 to September 1979. Belews Lake was considered oligotrophic; Salem Lake and Lake 150, eutrophic. A total of 32 species were found in the three lakes. Although the oligotrophic lake had as many species as the eutrophic lakes, many were rotifers, not truly littoral species, Belews Lake had 7 species of Cladocera vs. 11 in the eutrophic lakes. The eutrophic lakes had considerably more aquatic macrophytes in the littoral zone than the oligotrophic lake, providing a habitat able to support a greater number of zooplankton species. The littoral fauna, represented by certain taxa of Cladocera and Copepoda, had seasonal dynamics different from those of the limnetic fauna (Rotifera and Ostracoda), possibly as a result of predator pressure. There were no predators among the true littoral fauna, which were represented by Alona, Chydorus, Pleuroxus, Sida, Simocephalus, and Eucyclops. These genera showed very similar seasonal dynamics even in widely separated geographical regions, indicating that the population fluctuations were not dependent on climatic or chemical variables. Intrazooplankton predation by the limnetic species, mainly Cyclops bicuspidatus, appeared to be the major factor influencing the seasonal dynamics of the true littoral species. (Cassar-FRC)
W82-06911

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,
Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
For primary bibliographic entry see Field 5G.
W82-06912

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBE-ASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).
Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
A. Kohler.
Helgolander Meeresuntersuchungen, Vol 34, No 3, p 263-285, 1981. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Estuaries, *Fish, *Oxygen depletion, *Nuclear powerplants, Fishkill, Bioindicators, *Elbe river, *West Germany, Flounders, Eel, Smelt, Fish migration, Spawning, Entrainment, Water temperature, Water pollution, Cooling water, Industrial water, Seasonal variation, Rivers, Water pollution effects.

Continuous sampling of 22 species of fish (focusing on Platichthys flesus L., Osmerus eperlanus L., and Anguilla anguilla L.) was performed during 1978 at the intake of the cooling system of the nuclear power plant at Brunsbuttel in the Elbe estuary (West Germany). The goal of the study was to assess the influence of the abiotic factors water temperature, inflow from the upper Elbe and oxygen content of the river on the natural fluctuations of the fish community at various seasons and to investigate doubts about the efficacy of the fish-repelling device ('fish scarecrow') at the plant. It was found that seasonal changes in water temperature determined spawning times and migration.

The fish drawn into the cooling system formed a representative picture of the ichthyofauna of the estuary. The fish-repelling device was ineffective; it was estimated that when the cooling system was working at its full capacity of 130,000 cu m/hour at least 190,000 kg of fish and shrimp were drawn in and killed. Although the heavy pollution of the lower Elbe did not appear to affect water temperature, the oxygen content was largely dependent on the inflow of fresh water from the upper Elbe. The smelt spawning period was at least 44 days long, compared with 26.8 days at the end of the 1950s, and the fish only migrated upstream to the spawning areas at times of high freshwater inflow. A two-week period of severe oxygen depletion (5.19-6.2.1978) resulted in the largest fishkill in 30 years. This affected certain age groups of smelt and eel, while most flounder were able to migrate. A failure of the industrial filter plants at Brunsbuttel may have caused the oxygen depletion. (Gish-FRC)
W82-06913

SUBSTRATE-ASSOCIATED MICROFAUNA,
Environmental Protection Agency Region VI, Dallas, TX.
G. A. Burton, Jr., and J. M. Lazorchak.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 922-931, June, 1982. 88 Ref.

Descriptors: *Literature reviews, *Microenvironment, *Reviews, Benthic fauna, Aquatic animals, Benthos, Fauna, Benthic environment, Indicators, Bacteria, Heavy metals, Agricultureal chemicals, Pesticides, Water pollution effects, Microbiological studies, Water quality, Toxicity.

Current research in the area of substrate-associated microfauna is cited in this literature review. Methodology papers included discussions of sampling techniques, sampling devices, methods for studying benthic communities, and methods for investigating wastewater plant organisms. Ecology studies included the investigation of fouling communities and colonization of substrates, the distribution of substrate-associated microfauna, a one year study of water quality in Big Thicket National Preserve, factors affecting the distribution of littoral invertebrates, the distribution of micro-, meio-, and macrofauna biomass (suggesting nutrient inputs from intrusions of deep Gulf Stream waters) at the self break on the Georgia Bight, macro- and meiobenthos of Lake Michigan, benthic distribution studies in Antarctica, planktonic and benthic meiofaunal studies in saline lakes of Antarctica, the energetics of sandy beaches along South Africa, ciliates typical of waste treatment systems, effects of resource variation on the ciliate Tokophrya lemnarium, spatial distributions and interactions of Paramecium aurelia complex in littoral zones, protozoa and vascular vegetation in various wetlands, morphometric variability of the tardigrade Isohypsibius saltursus and several studies on the relationship between invertebrates and food uptake. Toxicity studies were made concerning thermal tolerances, chronic chlorination, petroleum responses, chlordane, endosulfan, methyl mercuric chloride, heavy metals, and wastewater pollution. Technical advances have been made in pollution studies. (Baker-FRC)
W82-06925

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 980-983, June, 1982. 24 Ref.

Descriptors: *Literature reviews, *Public health, *Reviews, *Drinking water, *Water pollution effects, *Human diseases, Salmonella, Legiionella pneumophila, Campylobacter jejuni, Pulmonary disease, Giardiasis, Gastroenteritis, Viruses, Cholera, Sparganosis, Epidemiology.

Current research into disease outbreaks cause by drinking water contaminants is cited in this literature review. During 1979 41 waterborne disease outbreaks were reported to the Centers for Disease Control and the US EPA. In epidemiological studies the incidence of amoebic and bacillary dysentery, infectious hepatitis, enterobiasis, and giardiasis before the afte construction of water tower reservoirs and automatic chlorination plants was considered in the Wadi Shati area in Libya. During 1981 only one waterborne clolera outbreak occurred in the US and was investigated. The incidence of cholera in a randomly selected sample of families in rural Bangladesh was followed over a 10 year period. Giardiasis was studied after a community wide outbreak of gastrointestinal illness occurred in Berlin, New Hampshire. Outbreaks of giardiasis were also studied in a small northwestern Pennsylvania town and in Arizona. Viral gastroenteritis was studied in cases caused by a virus serologically related to Norwalk virus near Tacoma, Washington in May of 1978. An outbreak of acute gastrointestinal illness at a camp in North Carolina was linked to a Norwalk type virus. A commonsurce waterborne epidemic of viral hepatitis was diagnosed in Kashmir, India. Campylobacter enteritis was studied after its occurrence in central Sweden, having been spread through infected water mains. Sparganosis was noted in persons haveing drunk water not from the local public water supply. Pulmonary disease was linked with shower fixtures from which Legionella pneumophila was isolated. Studies were also made of Mycobacterium xenopi as another pulmonary pathogen frequently isolated from tap water. (Baker-FRC)
W82-06928

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,
Oklahoma State Univ., Stillwater, Dept. of Botany.
D. A. Francko, and R. T. Heath.
Limnology and Oceanography, Vol 27, No 3, p 564-569, May, 1982. 4 Fig, 27 Ref.

Descriptors: *Bogs, *Chemical reactions, *Phosphorus, *Iron, *Humic acids, Ultraviolet radiation, Radiation, Light intensity, Lakes, *Bog lakes, *Ohio, Crazy Eddie Bog.

The release of orthophosphate from UV-sensitive complex P compounds was studied as a potentially ecologically important photodependent process involving the photoredution of iron. Lake water samples were collected from Crazy Eddie Bog, a shallow humic bog lake in northeastern Ohio. The lake is in a small old-field watershed surrounded by a marsh community dominated by Sphagnum. The concentration of dissolved humic substances in the water substances varied seasonally, being lowest in early spring, increasing in June, and reaching the highest concentration in late summer and early autumn. Throughout the season daytime concentrations of UV-sensitive complex P were linearly related to cochromatographic dissolved high molecular weight humic matter (DHM) adsorbance eluted in each chromatographed sample. The relationship was consistent in both relatively unstained and highly stained water samples. This fits in with the view that DHM had formed a complex with phosphate and that this complex can be broken by low doses of UV light. The UV in sunlight may have altered the DHM/phosphorus compounds, resulting in the release of phosphate. A diurnal fluctuation was noted both in the concentration of DHM and in the amount of UV-sensitive complex P. The amounts of DHM and UV-sensitive complex P were also linearly related. The rate of photoreduction of DHM/iron was the same as the rate of photoreduction of ferric citrate under similar conditions. Reduced DHM/iron was auto-oxidizable; ferrous citrate was not. These data support the view that orthophosphate sorbed to ferric iron/DHM complexes may be released by a mechanism involving UV-induced photoreduction of ferric iron to the ferrous state. (Baker-FRC)
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,
Water Research Lab., Columbus, OH., Div. of Water.
R. C. Lorenz, and C. E. Herdendorf.
Journal of Great Lakes Research, Vol 8, No 1, p 42-53, 1982. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Lakes, *Algal growth, *Lake Erie, Great Lakes, *Eutrophication, Phosphorus, Nitrogen, Nutrients, Seasonal variations.

In situ growth rates, densities and distribution of Cladophora were examined in the western basin of Lake Erie, and possible relationships between environmental conditions and Cladophora growth were examined. The findings showed that Cladophora colonized the littoral zone throughout western Lake Erie wherever suitable substrate was available. Within this littoral zone two distinctive growth patterns, representative of two different environments, are exhibited. The eulittoral zone supports growth from May to December, in contrast to the bimodal growth pattern of the infralittoral zone, which lacks growth in the late summer, August and September. Light and substrate availability limit the extent of Cladophora growth in western Lake Erie. Field observations indicated that light levels of about 50 microE/square meter-second or less are limiting. In the island region an extensive infralittoral zone composed of bedrock shorelines and reefs provides an excellent substrate for the alga to colonize. Much of the remaining Ohio and Michigan shorelines consists of low lying marshes and unconsolidated sediment, unsuitable for colonization. Available forms of phosphorus and nitrogen are abundant and do not become limiting, as evidenced by tissue nutrient analysis. The absence of the alga in the infralittoral zone during the late summer months of July and August is the result of a negaive energy balance. Respiration surpasses productivity as temperatures rise in the summer. The decreasing biomass of the infralittoral zone in the summer is accompanied by increasing epiphyte colonization and declining, but not limiting, tissue phosphorus and nitrogen levels. (Baker-FRC)
W82-06932

SECONDARY BENTHIC PRODUCTION IN A TROPICAL ISLAND STREAM,
Indiana State Board of Health, Indianapolis.
G. R. Bright.
Limnology and Oceanography, Vol 27, No 3, p 472-480, May, 1982. 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Tropical regions, *Benthos, Aquatic life, Climatic zones, Seasonal variations, Caroline Islands, Rainfall, Streams, Temperature effects, *Palan Islands, Ngerekiil River.

Benthic production was measured in a tropical stream on an oceanic island, the largest of the Palau group. The Palau Islands lie in the equaorial Pacific, 90 km east of the Philippines and an equal distance north of New Guinea. The climate is tropical and wet, with temperatures never deviating more than 6 degrees from a mean of 27 degrees C and rainfall averages of about 375 cm per year. The driest months are February through April. The study stream flows from its source about 150 meters above sea level for a 5 km distance and joins the larger Ngerekiil River near its estuary. The area of the watershed is 3.5 square km. Both the stream and the watershed are nearly pristine. There was no general pattern of synchronized life cycles tuned to seasonal changes as is typical in benthos of temperate streams. However, at least two important benthic species underwent population cycles possible related to seasonal precipitation changes. The shrimp A. pilipes had a peak population and standing crop in February, while the largest number of mature individuals was found in October. Larvae of the blackfly Simulium palauensis had a peak density and peak standing crop biomass in November, with the highest percentage of last instars in April. The outcrop and riffle communities in the stream were composed mainly of rheophilic species, but the community structures, mean densities, mean standing crops, and productions differed considerably. (Baker-FRC)
W82-06933

MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,
University of Southern California, Los Angeles, Dept. of Geological Sciences.
R. H. Osborne, G. R. Licari, and M. H. Link.
Sedimentary Geology, Vol 32, No 1/2, p 39-61, 1982. 8 Fig, 1 Tab, 38 Ref.

Descriptors: *Carbonates, *Algae, *Chemical precipitation, *Stromatolites, Walker Lake, *Nevada, Lakes, Shores, Cladophora, Ulothrix, Photosynthesis, Siliciclastic lakes, Chlorophyta, Cyanophyta, Carbon dioxide, Bicarbonates, Calcite, Benthic flora, Epilithic algae.

The occurrences of generalized and columnar stromatolites in a modern, closed siliciclastic lacustrine basin, Walker Lake, Nevada, and their formation by benthic and epilithic algal communities are documented. The two most abundant algae in the stromatolite community are Cladophora glomerata and a Ulothrix species. These are able to remove carbon dioxide from bicarbonate during photosynthesis, resulting in the precipitation of calcium carbonate, which is trapped and bound by an understory of green and blue-green algae. In the siliciclastic lakes stromatolite development seems to be restricted to shoreline and near shore environments. This characteristic can be useful in locating ancient lake shores. The biological and physical factors most important in the formation of stromatolites in this lake are summarized. Bedrock and stable pebble- to boulder- size clasts are suitable substrates for the benthic and epilithic algae. The best algal growth occurs in shallow, well-mixed, well-aerated, nonturbid water. Low Mg calcite precipitation, associated with the algal community, occurs in shoreline areas. Small generalized stromatolites form initially. These give rise to columnar forms. Periodic wave action erodes the stromatolites, providing a local source of carbonate sediments, usable for further stromatolite formation in an otherwise carbonate-poor lake. (Cassar-FRC)
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,
State Univ. of New York Coll. at Fredonia, Dept. of Biology.
K. E. Mantai, P. E. Garwood, and L. E. Peglowski.
Journal of Great Lakes Research, Vol 8, No 1, p 61-65, 1982. 2 Fig, 7 Ref.

Descriptors: *Algal growth, *Lakes, Nutrients, Phosphorus, Nitrogen, *Lake Erie, Great Lakes, Eutrophication, *Cladophora.

Biomass and several physiological and environmental parameters were measured dealing with Cladophora samples collected from two sites in eastern Lake Erie. Samples were collected from Point Gratiot and a Niagara Mohawk Paper Company breakwall. These sites are about 1 kilometer apart near the habor at Dunkirk, New York. Seasonal variation in standing crop was dramatic, with increases during early June, followed by a rather stable period culminating in a sharp decrease in Mid-July. The fluctuations in standing crop observed during June appeared to be caused by loss of algal material due to physical detachment of the filaments, followed by rapid regrowth. The data suggest that there is a maximum biomass level which, when attained, makes the cells more vulnerable to breakage. At the Niagara Mohawk Paper Company site the maximum biomass level was about 400 g dry wt/square meter. The mid-July drop in biomass represents the typical summer dieoff observed in many studies. A significant correlation was noted between biomass and chlorophyll content. Chlorophyll content tended to be high or increasing during periods of rapid growth, but was lower at times when biomass density decreased. Changes can occur rapidly in the time span of one day. Neither nitrogen nor phosphorus were limiting to the growth of Cladophora at the sites sampled. The mid-summer dieoff does not appear to be due to a simple nutrient deficiency. (Baker-FRC)
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,
Ontario Ministry of the Environment, Rexale, Limnology and Taxonomy Section.
M. B. Jackson, and Y. S. Hamdy.
Journal of Great Lakes Research, Vol 8, No 1, p 153-163, 1982. 7 Fig, 3 Tab, 35 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, *Cladophora, Georgian Bay.

The potential for Cladophora growth in the vicinity of a proposed municipal sewage treatment plant discharge to the Mary Ward Shoals area of southern Georgian Bay was investigated. A simple model is presented for predicting seasonal Cladophora production at three alternative discharge sites. Light, temperature, water movement and substrate characteristics of southern Georgian Bay provided favorable growth conditions for Cladophora. Growth appears limited by nutrient availability, as the alga grows only in association with local and well defined sources of nutrients such as harbor areas, municipal sewage treatment plant discharge locations, river and stream mouths, storm sewers, septic systems, and gull rookeries. Cladophora growth was severely phosphorus limited on the Mary Ward Shoals. Mean phosphorus concentrations on the Mary Ward Shoals at station SHB are above the suggested lower level for Cladophora growth. In spite of this, however, the alga is essentially absent from the shoal area. The reason is that average phosphorus concentrations in shallow nearshore areas do not necessarily reflect sustained or predominant external nutrient conditions. It was concluded that any proposed outfall should be long enough to ensure that the zone of impact does not encompass any water with depth shallower than 10 meters. Also, the sewage system should have a good outfall diffuser and the plant should be designed to produce an effluent quality of 500 micrograms phosphorus/liter or less. (Baker-FRC)
W82-06936

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,
Michigan University, Ann Arbor, Great Lakes Research Division.
R. J. Stevenson, and E. F. Stoermer.
Journal of Great Lakes Research, Vol 8, No 1, p 184-195, 1982. 9 Fig, 2 Tab, 20 Ref.

Descriptors: *Diatoms, *Lakes, *Lake Huron, Great Lakes, Algal growth, *Cladophora, Wastewater disposal, Nutrients, Wastewater pollution, Water pollution sources.

The population and taxocene patterns of diatoms on Cladophora in Lake Huron were investigated as a function of distance from a point source of municipal wastewater treatment plant effluent. The diatom proportion of the Cladophora-epiphyte assemblage biomass was also investigated. The study area was located near Harbor Beach, Michigan, on Lake Huron. Epiphytic diatoms were collected from July to September 1979 at various distances from a point source of municipal wastewater treatment plant effluent entering Lake Huron. Diatom accumulation rates were positively related to the distance from the point source. Despite higher nutrient concentrations nearest the point source, low accumulation rates of Cladophora epiphyte assemblage biomass and epiphytic diatoms indicated moderate growth inhibition by an undetermined factor. Evaluation of epiphytic diatom population abundance and ecology plus diatom taxocene species diversity supported the conclusions. A curvilinear relationship between diatom species diversity and impacts of growth inhibition is proposed. The diatom proportion of Cladophora epiphyte assemblage biomass was positively related to distance from the point source of sewage effluent. (Baker-FRC)
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,
Wisconsin University, Platteville.
M. L. Anderson, C. P. Rice, and C. C. Carl.
Journal of Great Lakes Research, Vol 8, No 1, p 196-200, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Lakes, *Lake Huron, Great Lakes, *Cladophora, Organic chemicals, Industrial wastes, Accumulation, Algae, Water pollution sources, Food chains.

The accumulation of polychlorinated biphenyls by Cladophora along the Lake Huron shoreline was investigated. Detectable quantities of PCB were found in all of the water samples that were collected. The chromatograms for the residues were composed of a mixture of Aroclors, with most of the peaks accounted for by standard mixtures of Aroclor 1242 and Aroclor 1254. The concentration of Aroclor 1242 in the water samples averaged 91 ng/liter, while Aroclor 1254 was 63 ng/liter. Total PCB concentration of 154 ng/liter included both dissolved (52%) and particulate (48%) phases. Two days pior to sample collection in the area a major storm eent passed through, causing a significant resuspension of the sediments in the zone. The Cladophora averaged 92 ng/g dry weight of total PCBs. About 58% of this total was in the Aroclor 1242 fraction. The PCB concentration of fish in the area ranged from 40 ng/g to 4,400 ng/g as wet weight of whole fish. The accumulation factors observed in the progression from Cladophora to net plankton to fish were 1:15:30. It was concluded that Cladophora may effectively moderate the passage of PCB through the nearshore food chain. The role of Cladophora as a source of PCBs seems more supportable than as a sink. (Baker-FRC)
W82-06938

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,
Michigan Technological Univ. Houghton, Dept. of Civil Engineering.
M. T. Auer, R. P. Canale, H. C. Grundler, and and Y. Matsuoka.
Journal of Great Lakes Research, Vol 8, No 1, p 73-83, 1982. 15 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Eutrophication, Great Lakes, *Monitoring, *Model studies, Mathematical models, *Cladophora, Nutrients, Phosphorus, Nitrogen.

The ecology of Cladophora glomerata in Lake Huron was examined in a three year study. A mathematical model was developed which would prove useful in evaluating various management strategies for the control of this algal growth. A municipal wastewater treatment plant discharge point at Harbor Beach, Michigan was linked with several nuisance occurrences of this alga in Lake Huron. An intensive field monitoring program was started to record weather conditions daily and levels of dissolved and stored phosphorus and standing crop of Cladophora. The distribution of Cladophora was essentially symmetrical about the nutrient source. Seasonal variation in biomass was noted following the pattern of early spring growth, stabilization and midsummer senescence. The high degree of spatial and temporal heterogeneity in the nearshore environment was clearly evident. Wind direction and velocity importantly affect dissolved phosphorus distribution. Internal phosphorus levels reflect long term trends in wind and current regimes. The growth of Cladophora is importantly influenced by internal phosphorus levels, while the loss of algal material through sloughing is closely correlated with wind-storm events. The observations of nearshore dynamics point to the need for high sampling frequency in such systems. (Baker-FRC)
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN

LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,
Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
M. T. Auer, and R. P. Canale.
Journal of Great Lakes Research, Vol 8, No 1, p 84-92, 1982. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Algal growth, *Lakes, Great Lakes, *Lake Huron, Eutrophication, *Model studies, Mathematical models, Kinetics, Phosphorus, *Cladophora.

The factors of dissolved phosphorus availability and internal phosphorus pool size were examined as they pertained to field populations of Cladophora glomerata in Lake Huron. Kinetic coefficients needed for modeling the uptake process are developed. The studies showed that Michaelis-Menten kinetics describe substrate/uptake interactions appropriately. Results from 35 experiments conducted over two field seasons emphasized that the phosphorus uptake rate increased as dissolved phosphorus availability increased. Negative feedback on uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate as internal pools approach saturation. The absolute maximum phosphorus uptake rate for Cladophora was 4.5 % P/day. Values for the half-saturation constant for uptake varied with internal phosphorus pool size and ranged between 30 and 250 micrograms phosphorus/liter. The data were fit to published mathematical expressions which describe uptake as a function of internal and external phosphorus levels. The expressions may be used in mathematical models simulating the growth of Cladophora. (Baker-FRC)
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,
Ecology and Environment, Incorporated, Buffalo, New York.
G. C. Millner, R. A. Sweeney, and V. R. Frederick.
Journal of Great Lakes Research, Vol 8, No 1, p 35-41, 1982. 5 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Erie, Great Lakes, Eutrophication, Nutrients, Nitrogen, Phosphorus, Seasonal variations, Biomass, Ammonia, *Cladophora.

The biomass and distribution of Cladophora were monitored at Lake Erie, and an attempt was made to determine possible relationships between environmental conditions and Cladophora biomass. Cladophora biomass reached peak values in late June and early July at both the Hamburg and Walnut Creek collection sites. Maximum biomass at the Hamburg sites was generally found at the 3 meter depth. The depth at which maximum biomass occurred at Walnut Creek varied with the time of year. However, the greatest biomass density generally occurred at the 12 meter and 1 meter sampling depths. The occurrence of biomass maxima at the 3 meter depth at the Hamburg site is thought to be more directly a function of physical disturbance at the shallower depths than of the presence of optimal growth conditions in deeper waters. The depth distribution of Cladophora at the Hamburg site may have been more greatly influenced by wave activity and drifting sand than at the Walnut Creek site. Greater sand accretion by waves associated with increased fetch between Hamburg and Walnut Creek and the prevailing southwest winds may be responsible for differences in Cladophora abundance with depth between the Hamburg and Walnut Creek sites. Reductions in Cladophora internal nutrient levels corresponded to decreased nutrients in the water. Internal total phosphorus levels showed a significant positive correlation with Cladophora biomass. Cladophora was nitrogen-limited at the Walnut Creek site during part of the study period. Nitrate + nitrite nitrogen showed a significant positive correlation with Cladophora biomass at that site. (Baker-FRC)
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,
Limnos Limited, Toronto, Ontario.
J. H. Neil, and M. B. Jackson.
Journal of Great Lakes Research, Vol 8, No 1, p 30-34, 1982. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Lakes, *Algal growth, *Phosphorus, *Lake Erie, Great Lakes, Seasonal variations, *Cladophora, Eutrophication, Nutrients.

Environmental conditions, Cladophora standing crop, and internal nutrient levels were determined in Lake Erie. The role of phosphorus in Cladophora growth was also investigated. The Rathfon Point study site was characterized by a series of shelving limesone points which annually support a heavy growth of Cladophora. The temperature at this spot reached 20 degrees C in late June and generally remained above this level until early September. Water clarity was variable, due principally to suspended materials associated with wind conditions. Phosphorus and nitrogen parameters which describe the nutrient environment showed some sample-to-sample variability but lacked any trend consistent with the observed changes in Cladophora standing crop. Nitrate-nitrogen levels showed a consistent reduction throughout the growing season, while soluble reactive phosphorus levels remained very low, approaching the limit of detection most of the time. The percent of coverage by Cladophora increased with increases in fertility, suggesting that growth within the physical limits established by the environment will vary directly with the availability of plant nutrients. Optimum growth occurred between temperatures of 10 and 20 degrees C. Data indicated that above 20 degrees C the plant becomes chlorotic, growth is limited and the biomass may be detached from the substrate. Phosphorus additions did not affect Cladophora growth until the fall, when water temperatures fell below 20 degrees C and vigorous growth was resumed in the vicinity of the experimental phosphorus discharge pipe. (Baker-FRC)
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,
Indiana Univ., Bloomington. Dept. of Biology.
D. H. Landers.
Limnology and Oceanography, Vol 27, No 3, p 428-439, May, 1982. 11 Fig, 5 Tab, 37 Ref. OWRT B-009-IND.

Descriptors: *Macrophytes, *Nutrients, Phosphorus, Nitrogen, Seasonal variation, Reservoirs, Lakes, Impoundments, Myriophyllum spicatum, Water analysis, *Chlorophyll, *Indiana, Decomposing organic matter, Phytoplankton, Biomass, Monroe Reservoir.

The effects of senescing stands of Myriophyllum spicatum on water chemistry and chlorophyll a were investigated in a large soft-water Indiana reservoir having an area of 16.8 square kilometers and a mean depth of 5.2 meters. A causeway divides the reservoir into two basins, and one narrow cut allows exchange between them. Annual and seasonal growing conditions for submerged aquatic plants in Monroe Reservoir can vary drastically. Most seasonal variation results from water level fluctuations far greater than in a natural lake of similar size. Differential temperature effects on decomposition were discounted as inconsequential. Replicate enclosures were used to isolate water columns over monospecific stands of M. spicatum until annual dieback began. Systems were sampled routinely for 119 days before, during and after fall dieback. Decomposing macrophytes supplied significant inputs of nitrogen and phosphorus to surrounding waters. Nitrogen inputs were sharply pulsed and never accounted for more than 2.2% of the annual allochthonous inputs. Phosphorus inputs from senescing plants equaled up to 18% of the annual total phosphorus loading for the reservoir. Annual dieback occurred in late summer and early autumn when conditions were suitable for phytoplankton response. Phytoplankton biomass showed significant increases in response to senescing macrophytes. (Baker-FRC)
W82-06943

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,
Lancaster University (United Kingdom), Department of Biological Sciences.
K. Jones.
Limnology and Oceanography, Vol 27, No 3, p 455-460, May, 1982. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Estuarine environment, *Nitrogen fixation, Estuaries, Environment, *England, Coastal waters, Sediments, River Lune estuary, Rivers, Temperature effects.

Acetylene reduction was studied in Morecambe Bay, which is comprised of large areas of tidal flats off the northwest coast of England. The sediments are soft enough to allow insertion of hollow cylinders without disturbing the particle distribution and moist enough to form gas-tight seals so that changes in the composition of gases in the cylinders can be monitored. Experiments were conducted in the Lune estuary near Lancaster. The results of in situ assays performed at monthly intervals indicate that nitrogen fixation occurs only from May through October and that the highest values coincided with the highest temperatures. Nitrogen fixing bacteria were most numerous in the surface layer, and only the Enterobacteriaceae and Desulfovibrio were abundant. The effects of temperature on acetylene reduction by cores were studied in the laboratory. Rates were maximal between 30 and 35 C and there was little activity below 10 C. Bacterial isolates tested for the effects of temperature on acetylene reduction showed a pattern similar to that found in the sediments. That is, they exhibited little activity at low temperatures and had optima at just above 30 degrees C. The dominating aquatic influence on the estuary was marine. Although the sediments contained low numbers of photosynthetic bacteria and cyanobacteria, some of those present are salinity tolerant and may contribute some fixed nitrogen to the sediments. It is unlikely that photosynthetic microorganisms play a significant part in sediment nitrogen fixation. Considerable increases in acetylene reduction were noted when cores were primed with carbon substrates. (Baker-FRC)
W82-06944

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,
Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. H. Everest, and W. R. Meehan.
In: Transactions of the 46th North American Wildlife and Natural Resources Conference, 1981, Wildlife Management Institute, Washington, D.C., p 521-530, 21 Ref.

Descriptors: *Forest management, *Range management, *Aquatic habitats, *Anadromous fish, *Logging, Erosion, Road construction, Grazing, Stream banks, Scour, Detritus, Organic matter, Dissolved oxygen, Water pollution sources, *Pacific Northwest U.S., Alaska.

The anadromous fishery resources of western North American are produced largely within forested watersheds. Forest and rangeland management activities that can influence the quality of anadromous fish habitat include timber harvest, road construction, and livestock grazing. Organic debris from forested watersheds of the Pacific Northwest and Alaska enters streams through direct litterfall, landslides, debris torrents, timber felling, and streambank erosion, plus blowdown of trees and branches. Large woody debris can create habitat for rearing salmonids, but may cause sedimentation in spawning areas. Large, naturally occurring debris can promote streambank stability and reduce streambed scour. Large accumulations of fine organic debris can adversely affect habitat by reducing dissolved oxygen and producing toxic leachates. Total removal of debris can result in a completely open channel, promoting streambed

sour, steambank instability, and loss of fish habitat productivity. Debris torrents, a common mass erosion event in the Pacific Northwest, have a negative impact on habitat and production of anadromous salmonids in small streams immediately downstream from the torrent egress. Studies within a 1-mile reach of Knowles Creek, however, indicate that the total effect of debris torrents in that sediment-poor watershed tends to be positive. Preliminary results of a livestock grazing study do not show profound effects on fish populations among various grazing systems or between one to three years of season-long grazing and ungrazed controls. (Moore-SRC)
W82-06965

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,
Southeastern Forest Experiment Station, Asheville, NC.
T. J. Harshbarger, and P. E. Porter.
Forest Service Research Note SE-308, June, 1982. 10 p, 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Dam effects, *Environmental effects, *Wastewater pollution, *Fish populations, *Water pollution effects, Invertebrates, Nutrients, Oligotrophy, Fish migration, Fish food organisms, Biomass, Bacteria, Periphyton, Trout, *Appalachian region.

Bent Creek is a third-order stream which supports a put-and-take trout fishery in North Carolina. An undisturbed section of the stream, Station 1, was located 250 m above Lake Powhatan, a 1.6-ha recreational impoundment. Impacted sites were Station 2, 100 m below Powhatan Dam; Station 3, 3,300 m below Station 2 and immediately below the confluence of Wesley Branch; and Station 4, 300 m below Wesley Branch. Wesley Branch is a first-order stream which receives 380,000 l/d of secondary sewage from a treatment plant. Treated sewage added to Bent Creek increased bacterial production by 476%, periphyton production by 191%, and the number of benthic macroinvertebrates by 441% biomass of fish decreased 56%. At Station 4, fish biomass was significantly greater than it was at upstream unenriched sections. Over the 300-m reach of water below Wesley Branch, nutrients decreased dramatically. The dam influenced fish distribution and upstream migration. The dam did not appreciably affect the number of macroinvertebrate taxa, but it did increase the abundance of some, particularly filter-feeding caddisflies and midges. It did not greatly alter physiochemical characteristics of the stream during the period of study. Tentatively, results indicate that sewage will change the ecology of oligotrophic streams like Bent Creek, but if it does enhance the production of a desired species, it may not be considered harmful. (Moore-SRC)
W82-06966

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,
Ontario Ministry of the Environment, Rexdale.
B. D. LaZerte, and J. E. Szalados.
Linnology and Oceanography, Vol 27, No 3, p 413-418, May, 1982. 3 Fig, 1 Tab, 36 Ref.

Descriptors: *Macrophytes, *Natural waters, Plants, Carbon, Lakes, Dissolved inorganic carbon, Lake Memphremagog, Fluctuations, Radioactive tracers, Isotope studies, *Quebec, Path of pollutants.

The stable carbon isotope ratio of submerged freshwater macrophytes was examined and an initial estimate was offered as to whether the organic carbon in a submerged macrophyte bed is autochthonous or of terrestrial origin. Major terrestrial carbon sources were wood and deciduous leaf litter. The results indicated that all stable carbon isotope ratios of the submerged macrophytes were substantially higher than those of terrestial C3 leaf litter and higher than the organic carbon ratios of a few preliminary sediment samples from one macrophyte bed in Lake Memphremagog. Epilimnetic dissolved inorganic carbon (DIC) ranged from 0.08 to 0.95 mM and pH from 7.4 to 8.1 over the summer season and along the main axis of the lake. The carbon ratio of the DIC was lower than that of DIC in equilibrium with the atmosphere; however, actual values varied widely. Variation was greatest at the southern end of the lake, where the influence of the inflowing rivers was most pronounced. It was concluded that the organic carbon of submerged freshwater macrophytes has a stable carbon isotope ratio distinctly higher than that of terrestrial C3 plants. This difference is probably a result of differences in diffusion resistance to carbon dioxide rather than of carbon dioxide fixation pathways, but is also influenced by the stable carbon isotope ratio of the DIC in the water. As a result, the stable carbon isotope ratio of these submerged freshwater macrophytes can be used to distinguish between them and terrestrial C3 material as sources of carbon in littoral communities. (Baker-FRC)
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
For primary bibliographic entry see Field 5B.
W82-06973

CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),
Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5A.
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,
Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W82-06975

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,
Wisconsin Univ.-Milwaukee, Dept. of Botany.
J. L. Blum.
Journal of Great Lakes Research, Vol 8, No 1, p 10-15, 1982. 5 Fig, 5 Ref.

Descriptors: *Algae, *Lakes, *Lake Michigan, Great Lakes, *Algal growth, Eutrophication, *Lake shorelines.

The seasonal development and spatial variation in the major components of attached algal populations on breakwalls and at other harbor and offshore sites on the western Lake Michigan shoreline are described. The discussion is presented on a seasonal basis, with the development of each algal component described chronologically. Evidence indicates that temperature, insolation, nutrient levels, wave action, and water level are important environmental factors which determine this pattern . Specific factors which determine the relative abundance of species within the waterline algal community may only be defined through careful autecological analysis. Field observations indicate that light requirements, resistance to desiccation and ice scour, and reproductive strategies are highly important features of the algal population dynamics of the nearshore environment. Of the three major filamentous algal forms present in this habitat, Bangia appears as a permanent resident, while Ulothrix may be considered a seasonal and opportunistic plant, responding rapidly to changes in water level. Cladophora is a perennial, but plants above a depth of about 30 cm tend to grow as annuals due to conditions of ice scour. It is suggested that seasonal and spatial variation in the abundance of particular species is related to the physical growth requirements of the species. (Baker-FRC)
W82-06976

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,
McGill Univ., Montreal,(Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06977

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,
Utah State Univ., Logan. Dept. of Biology.
R. D. R. Parker, and D. B. Drown.
Journal of Great Lakes Research, Vol 8, No 1, p 16-26, 1982. 11 Fig, 1 Tab, 35 Ref.

Descriptors: *Lakes, *Algal growth, Eutrophication, *Phosphorus, Nutrients, *Ulothrix zonata, *Lake Superior, Great Lakes, Phosphates.

The impact of phosphorus enrichment was determined and wave action was simulated on new and previously established populations of Ulothrix zonata from the north shore of Lake Superior. Baseline information was provided on the composition and magnitude of the periphyton community of Lake Superior. Tanks received constant flow of lake water and were exposed to the same insolation and climatic conditions as the lake for a 10-week period during July, August, and September 1972. A rocking tank and a stationary tank were enriched to maintain an average concentration of 0.16 mg/liter of phosphate phosphorus. Two remaining tanks, receiving only lake water, served as controls. Each week, algal material was harvested from the tanks and analyzed for chlorophyll a, ash-free dry weight, and abundance of U. zonata and associated non-filamentous periphytic algae. Diatoms comprised, on the average, 95% of the total non-filamentous periphytic algae. The results demonstrated that phosphorus enrichment had marked effects on established populations of U. zonata in addition to favoring recolonization of U. zonata on bare rock substrates. Statistical analysis of the data revealed that phosphorus enrichment caused a significant increase in Ulothrix biomass and chlorophyll a in the enriched tanks. Wave simulation caused a significant reduction in total numbers of non-filamentous algae associated with Ulothrix in the rocking tanks. (Baker-FRC)
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,
All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
V. V. Sapozhnikov, G. G. Shinkar, and A. A. Georgiev.
Water Resources, Vol 8, No 4, p 443-448, July/August, 1981. 3 Fig, 7 Ref. Translated from Vodnye Resursy, No 4, p 161-167, July/August, 1981.

Descriptors: *Eutrophication, *Oxygen, *Algae, Photosynthesis, Biological oxygen demand, Primary productivity, Reservoirs, Organic matter, Mozhaisk Reservoir, Measuring instruments, Wave action, Producitivity, Diurnal distribution, Hydrogen ion concentration, *USSR.

Oxygen concentration, primary production, and destruction were continuously measured by a production meter in the waters of Mozhaisk Reservoir.Galvanic-type electrochemical sensors using Ag and Pb in a 3M KOH solution were used as electrodes for measuring oxygen concentration. The meter recorded temperature, underwater illumination, and oxygen concentration; pH was determined by a separate meter. Diurnal variations of oxygen concentration ranged from 8.3 mg per liter at midnight to 8.6 mg per liter at 1400-1500 hours. At 1430 hours there was a temporary decrease to 8.4 mg per liter. The pH followed the same pattern from an 8.6 minimum to 8.8 maximum, with a slight, temporary decrease at 1430 hours. Gross and net production were illustrated in graphs for August 16, 1978. Net production measured by the production meter was 7.85 mg oxygen per liter, 6

times more than measured by the bottle technique. Maximum destruction values were recorded in the morning and at 4-4:30 pm. The maximum BOD recorded by the production meter was 0.20 mg oxygen per 30 min, 9 times higher than that measured by the bottle techniue. During stormy weather, heavy cloud cover and wave action increased BOD markedly due to a reduction in photosynthesis, an increase in suspended matter, and the death of cells. (Cassar-FRC)
W82-06982

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,
Belorussian State Univ., Minok (USSR).
G. A. Inkina.
Water Resources, Vol 8, No 4, p 448-452, July/August, 1981. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 4, p 168-173, July/August, 1981.

Descriptors: *Bacteria, *Wastewater pollution, *Self-purification, Water pollution effects, Rivers, *USSR, Plankton, Growth rates, Respiration, Microbiological studies.

The total number of planktonic bacteria, generation time, respiration rate, and efficiency of food assimilation were reported for several USSR rivers with varying anthropogenic loads. Volumes of individual bacterial cells varied from 0.10 to 0.27 cu microns for cocci and 0.50-0.76 cu microns for bacilli. Average numbers of bacteria ranged from 2.6 million cells per ml in the Volga to 17.72 million cells per ml in the polluted Svislock's River. There were significant increases in bacteria, up to 6-fold, below most municipal wastewater outfalls. Generation times were 18-44 hours, least in the Volga and most in the Dnepr. Downstream from wastewater outfalls the rates of reproduction were generally depressed. Average reproduction rates in unpolluted and mildly polluted rivers were 0.13 + or - 0.02 times 10 to the minus 9th power at 20 C. Wastewater from certain large cities increased this rate up to 10 times. The efficiency of use of assimilated energy by bacteria for their growth was 3-67%, average 33%. Values for sites downstream of cities were up to 10-fold less than upstream values. (Cassar-FRC)
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).
A. I. Kovrizhnykh, and L. I. Glavish.
Water Resources, Vol 8, No 4, p 452-456, July/August, 1981. 1 Fig, 11 Ref. Translated from Vodnye Resursy, No 4, p 174-179, July/August, 1981.

Descriptors: *Phytoplankton, *Self-purification, *Eutrophication, Water pollution effects, Water quality, Northern Donets-Donbas Canal, Canals, Diatoms, Nutrients, Algae, Organic matter, Heterotrophic bacteria, Bacteria, Biological oxygen demand, Stephanodiscus hantzshii, Cyanophyta, *USSR.

The phytoplankton of the flatland, river-fed Northern Donets-Donbas Canal, USSR, was dominated by diatoms, particularly Stephanodiscus hantzshii Grun., in the winter-spring period. The maximum number of S. hantzshii was 19,400-108,000 cells per ml during 1969-78, except for 1976, when the number did not exceed 5900 cells per ml. In some years several species of blue-green algae entered the canal from the Krasnooskol'skoe Reservoir, the incoming water containing from 17,900 to 223,800 blue-green algal cells per ml. During the periods of bloom water quality improved due to uptake of biogenic elements by the algae. Levels of ammonium, nitrite, nitrate, silicon, Fe, and phosphate were less than levels in incoming water. However, the organic matter comprising the phytoplankton greatly increased the load on water treatment plants, to a total of 52.8 tons per day fresh weight on one occasion. Although BOD5 increased during algal blooms, the relationship was not directly proportional. Generally the BOD in water leaving the canal was 10-99% greater than that entering it; on extreme occasions 133% and 214% increases were observed. In the presence of negligible diatom populations there was a 19-24% decrease in organic matter in outflowing water compared with inflowing water. As the diatoms died and decomposed, heterotrophic bacteria increased in number to 35-194% greater than in incoming water. These values were up to 14 times higher on certain occasions. Blue-green algae affected water quality similarly, but to a lesser degree, because they exist in lesser numbers. (Cassar-FRC)
W82-06987

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and A. H. Woodcock.
Pacific Science, Vol 35, No 3, p 257-261, July, 1981. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Eutrophication, *Drought, *Water level fluctuations, *Phytoplankton, Lakes, Eutrophied lakes, Mountain lakes, Alpine regions, Perched groundwater, Groundwater movement, Chlorophyll a, Nutrients, Interstitial water, Volcanos, Lake Waiau, *Hawaii, Nitrogen, Algae, Water pollution effects.

A drought during 1976-78 caused hypereutrophication in Lake Waiau, Hawaii, a small perched alpine lake near the top of the dormant volcano, Mauna Kea. This lake is remote from human influence. The volume of the lake decreased from 11,600 cu m to 3,700 cu m from May 1977 to March 1978. The lake level dropped from the normal yearly low of 25-30 cm below the overflow level to 180 cm below overflow in 1978. August chlorophyll a concentrations were (in mg per cu m): 17 in 1977, 6800 in 1978, 413 in 1979, and 280 in 1980. The usual phytoplankton community of diatoms and chlorophytes was replaced by an almost complete monoculture of the chlorophyte Nannochloris bacillaris. Nutrients to support this bloom were supplied by inflow of nutrient-rich interstitial water, especially in the nearshore areas, as a result of a 20-70 cm hydrostatic head between the perched groundwater around the lake and the lake surface. Two years after the drought's end, chlorophyll a levels were still higher than predrought levels. (Cassar-FRC)
W82-06991

5D. Waste Treatment Processes

A NOTE ON THE EFFECT OF CHLORINATION OF SEWAGE EFFLUENTS ON FAECAL COLIFORM TO FAECAL STREPTOCOCCI RATIOS IN THE DIFFERENTIATION OF FAECAL POLLUTION SOURCES,
Hydrological Research Inst., Pretoria (South Africa).
P. A. E. Rosser, and D. P. Sartory.
Water S. A., Vol 8, No 1, p 66-68, January, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Chlorinatiion, *Sewage bacteria, Bacteria, Coliforms, Streptococci, Wastewater treatment, Disinfection, Microbiological analysis, Water pollution sources, Effluents, Secondary wastewater treatment, Feces.

Data are presented on the effect of chlorination of purified sewage effluents on fecal coliform (FC):fecal steptococci (FS) ratios. Samples were routinely collected over a period of six months from the sewage works northeast of Pretoria, covering periods before and after commencement of chlorination of the effluent. Secondary purified unchlorinated sewage effluent samples were also collected from this sewage works for study. Results indicate that fecal streptococci are more resistant to chlorination than are fecal coliforms. This greater resistance to chlorine by fecal streptococci results in a significant lowering of the FC:FS ratio following chlorination of purified sewage effluents. When purified effluents are chlorinated, greatly reduced FC:FS ratios are recorded, in some cases indicating animal fecal pollution from a domestic sewage source. Thus the indicative power of the PC:FS ratio to differentiate pollution types is abrogated. Under present circumstances, where even small scale sewage works chlorinate their effluent, the use of the FC:FS ratio to predict fecal pollution type must be treated with great caution. (Baker-FRC)
W82-05902

WASTEWATER REUSE USING MICROGRAS DISPERSION STRIPPING,
Shaler (Amos J.), Inc., State College, PA.
A. J. Shaler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243353, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-81/4, May 1981. 180 p, 29 Fig, 46 Tab, 35 Ref, 4 Append. OWRT-C-802620-R(8807)(1).

Descriptors: *Water reuse, *Flotation, *Wastewater treatment, *Industrial wastewater, Water quality control, *Water pollution prevention, Industrial development, Process control, Industrial wastes, Water treatment, Design criteria, Water quality, Pollutants, Water pollution treatment, Environmental control, Water pollution sources, Liquid wastes, Wastewater management.

Investigation was made of micro gas dispersion (MGD) flotation of heavily-loaded complex wastewaters, a new flotation process, which focused on wastes from an industrial laundry since they represented the kinds of mixed contaminations found in wastes from the laundry's industrial clients. Wastewaters from some client plants and from nonlaundry clients which produce simpler but more heavily-laden wastewaters were also studied. The overall investigation sought to produce a recyclable effluent. All wastewaters were successfully clarified in two flotation steps. This process (tested in test-tube batteries, separating funnels, and in a two-column test stand) included automatic pH correction, flotation with an MGD, a second pH correction, and a second MGD flotation. Optimum composition of the MGDs were sought. The successful MGDs contained 40-60% air by volume, water which became recycled, about 100 ppm of surfactants, and about 1000 ppm of a flocculant. For industrial laundry wastewaters, non-metallic contaminants were reduced from thousands of ppm at removal ratios of 3-275 (67-99.6% removal); metallic constituents were reduced from up to 25 ppm at ratios up to 10,000 (99.99% removal). Wastewaters from other sources were generally more easily clarified. (Zielinski-MAXIMA)
W82-05911

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
P. B. Belt, T. W. Joyce, and H-M. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243379, Price codes: A06 in paper copy, A01 in microfiche. Report No 175, November 1981. 97 p, 12 Fig, 25 Tab, 71 Ref, 5 Append. OWRT A-116-NC(1), 14-34-0001-0135.

Descriptors: *Pulp washing, Pine trees, *Chlorination, *Bleaching wastes, Pulp and paper industry, Kraft mills, *Pulp wastes, Industrial wastes, Chlorine, Pollutants, Water pollution sources, Water pollution control, Effluents, Tensile strength, Environmental control, Water quality control, *Wastewater treatment.

The strength and effluent characteristics of variously bleached southern pine kraft pulps were assessed. High-brightness pulps were produced in sequences of chlorination (C), alkaline extraction (E) and chlorine dioxide (C) treatment, with/without oxygen pre-bleaching. Sequences used were CEDED (conventional bleaching) and CED (oxygen pre-bleaching), with first-stage sequential chlorine dioxide substitution. Effleunts from the various stages were tested for BOD, COD, color, chlorides, mutagenicity and Daphnia toxicity. sim-

ulated whole mill effluents for each sequence were applied to bench-scale aerated lagoons to assess their biological treatability in a conventional wastewater treatment system. The results indicated that substantial pollutant output reductions can be achieved by use of oxygen bleaching and total recycle of the oxygen stage effluent: Use of D in the first stage chlorination had little effect on BOD and COD. Effluents from the aerated lagoon were non-toxic and non-mutagenic. The results of pulp strength tests indicated that oxygen pre-bleaching successfully produces a high-brightness pulp with strength characteristics similar to that produced by conventional bleaching sequences. (Zielinski-MASIMA)
W82-05913

UV DISINFECTION FOR ONSITE SAND FILTER EFFLUENT,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and S. Romatzick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243601, Price codes: A03 in paper copy, A01 in microfiche. May, 1982. 32 p, 11 Fig, 1 Tab, 9 Ref. OWRT A-051-ME(1).

Descriptors: *Disinfection, effluents, *Sand filters, *Wastewater treatment, *Ultraviolet disinfection, Cost analysis, *Cost comparisons, Feasibility studies.

The technical and economic feasibility of using ultraviolet (uv) light as a viable alternative to chlorine as the required disinfectant for onsite sand filter effluents discharged to surface waters in Maine was determined. To obtain a reliable cross section of performance for sand filters in Maine, 74 filters were selected for an effluent characterization program. The effluent characterization study allowed general conclusions to be made with regard to the potential of uv disinfection. A simple suspended lamp uv disinfection unit was designed, constructed, and tested in the laboratory and in the field. The efficiency of the uv disinfection unit was determined through field testing at 10 of the 74 sand filter sites used in the effluent characterization program. The 10 test sites accurately reflected the broad spectrum of effluent quality that exists in the field, ensuring that the results of the study would be generally applicable to all sand filters. Performance testing demonstrated that the suspended lamp disinfection unit is capable of nearly complete disinfection for fecal coliform over the range of effluent quality which exists in the field. An economic comparison of the uv unit vs. the tablet chlorinator demonstrated that the initial equipment costs for the two systems are approximately equal; however, the annual operating cost for the uv unit is less than for the tablet chlorinator. In addition, the maintenance requirements and potential field problems were estimated to be far fewer than those associated with a tablet chlorinator. (Author abstract)
W82-05937

WASTE TREATMENT SYSTEM RETROFITTED WITHIN DEADLINE,
B. B. Hall, T. L. Shepard, and P. A. Peterson.
Power Engineering, Vol 86, No 5, p 58-59, May 1982. 1 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Electric powerplants, *Chemical treatment, Effluent limitations, Coal, Chemical precipitation, Settling basins, Air pollution, Fly ash, Filtration, Vacuum filters, Weirs, Wastewater facilities, Waste disposal, *Minnesota.

In 1975, the Minnesota Pollution Control Agency issued a permit authorizing the wastewater discharges from the Fox Lake power station of the Interstate Power Company in accordance with the limitations of the Federal Water Pollution Control Act. In 1979, Litz, Daily and Brain studied the discharge requirements of the power plants practical and economical way to handle wastes. It was decided that a new treatment facility costing over $1.5 million would be fully retrofitted by March 1981. Under the new system, each waste stream will be handled separately. Dry flyash handling was recommended for potential resale to concrete mix plants, while treatment of boiler blowdown and air heater washwater is carried out by chemical precipitation and filtration in batch treatment. After precipitation, the wastewater is pumped from an equalization basin to a diatomaceous earth precoat vacuum filter which combines other miscellaneous wastes before discharge to the lake. Diversion channels were constructed around the coal storage area to collect rainfall runoff, while a retention basin was provided for the settling of suspended solids from the runoff. An overflow weir was included at the outlet of the basin to regulate the discharge and control the carryover of coal fines. (Geiger-FRC)
W82-05947

NITROGEN REMOVAL IN CONTINUOUS-FLOW SEQUENTIALLY AEREATED ACTIVATED SLUDGE SYSTEMS,
State Pollution Control Commission, Sydney (Australia).
M. C. Goronszy, and D. Barnes.
Process Biochemistry, Vol 17, No 1, p 13-19, January/February, 1982. 5 Fig, 4 Tab, 36 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrification, *Wastewater treatment, Nitrogen removal, Aerobic conditions, Anaerobic conditions, Dissolved oxygen, Nitrates, Oxygen uptake, Organic loading, Ammonia, Aeration, Temperature effects.

A 3-year study on nitrogen removal in full scale continuous activated sludge systems used intermittent aerobic-anoxic conditions and domestic wastewater as a carbon source and electron donor. The plant operated in four 6-hour cycles. Mean total N. removals were greater than 85%, with most off the residual N in the organic form; residual ammonia-N was zero or nearly zero. Temperatures below 10 C reduced removal efficiencies by about 10%. When the dissolved oxygen concentrations present during the aerobic sequence (optimum 4 mg per liter) were adjusted to the applied organic load, anoxic conditions were maximized. In a conventional system using methanol and a sludge with a denitrification rate of 12 g nitrate N per g MLSS per day at 25 C, an anoxic retention time of 2 hours (of the 6 hour cycle) was necessary to denitrify 25 mg per liter of Nitrate in 24 hrs. In the continuous feed sequential system a total of 28 g of oxidized N can be denitrified every 24 hours during the anoxic sequence with a food/microorganism ratio of 0.05 and an average denitrification rate of 0.03 kg nitrate-N per kg MLSS per day. Additional denitrification occurs during the aerobic sequence for a total of 35 mg per liter per day. (Cassar-FRC)
W82-05950

SOLVING A POOR OXYGEN TRANSFER PROBLEM.
Public Works, Vol 113, No 5, p 88, May, 1982.

Descriptors: *Oxygen transfer, *Aeration, *Wastewater treatment, Energy, Diffusers, Montecito, *California, Cost analysis.

An investment of $17,000 saved $19,000 in energy costs the first year at the Montecito, California, wastewater treatment plant. The extended aeration plant receives somewhat more than its 0.75 mgd capacity. As a result adequate dissolved oxygen was hard to maintain in the reactors during 1978-79. The existing 392 coarse bubble diffusers were replaced with FMC Corporation SP35 Pearlcomb fine bubble diffusers. In addition to saving energy costs for blower operation, blower wear has been reduced and clogging of diffusers has been eliminated. (Cassar-FRC)
W82-05952

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,
Eco-Research Ltd., Inc., Point-Claire (Quebec).
S. M. Shere, and P. G. Daly.
Pulp and Paper Canada, Vol 83, Convention Issue, p 62-66, March, 1982. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Pulp and paper industry, *Biological treatment, *Toxicity, Fish, Trout, Mortality, *Wastewater treatment, Industrial wastewater, Mixing, Oxygenation, *Thermomechanical pulping process, *Pulp wastes.

Wastewater from the thermomechanical pulping process (TMP) was treated biologically in a laboratory aerobic fermenter using high oxygen concentrations (above 3 mg per liter) and rapid mixing (900 rpm and Reynlds number greater than 100,000). The pH and temperature were maintained at 7.0 and 30 C, respectively. Total BOD removal was 96% at food/microorganism ratios of 0.9-1.7 per day and 74% at ratio of 3.6-4.5. Total COD removals were 80% amd 61%, respectively. Raw wastewater contained 1000 mg per liter total BOD and 2650 mg per liter total COD. In toxicity tests juvenile rainbow trout suffered 100% mortality when exposed to 18% influent for 96 hours. No mortality was seen in fish exposed to 100% effluent for the same time. (Cassar-FRC)
W82-05955

COPPER REMOVAL BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, and E. L. Thackston.
Separation Science and Technology, Vol 17, No 2, p 359-367, 1982. 1 Fig, 7 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Copper, Heavy metals, Industrial wastes, *Metal-finishing wastes, Metals, Colloids, Adsorption, Separation techniques, Recycling, *Foam separation, *Flotation.

A project was designed to test the foam flotation process on metal plating wastes. The results obtained by a large continuous flow pilot plant treating a simulated copper-bearing waste are presented. Ferric chloride was added to the wastewater to form a ferric hydroxide precipitate which acted as the adsorbent in the adsorption process. Adjustment of the pH was accomplished using sodium hydroxide, and sodium lauryl sulfate was the surfactant. Simulated copper bearing wastewaters were prepared by dissolving copper sulfate in tap water, then adjusting the pH to prevent the precipitation of copper carbonate. The variables having an influence on the efficiency of the system which were studied are pH, Fe(III) and sodium lauryl sulfate concentrations, wastewater hydraulic loading rate, ionic strength, and air flow rate. At pH values higher than 7.4, the decrease in flotation efficiency leads to the presence of some ferric hydroxide in the effluent. The optimum Fe(III) concentration seems to be between 90 and 100 mg/liter. For sodium lauryl sulfate the concentration of 15 mg/liter seemed sufficient to maintain a good, stable foam pattern in the column. Increasing the hydraulic loading rate let to a decrease in copper removal efficiency. Air flow rates of 11 to 13 nitrogen cubic meters/square meter/hour were sufficient to provide a good performance of the flotation column. Increasing ionic strength has a negative influence on the treatment efficiency. Good results were achieved up to 0.5 M sodium chloride concentrations. The results indicate that sodium lauryl sulfate recovery from the foamate and recycling back to the system are possible after sodium hydroxide treatment. (Baker-FRC)
W82-05960

RECOVERY OF FINE-PARTICLE COAL BY COLLOID FLOTATION,
Ohio State Univ., Columbus. Water Resources Center.
A. J. Rubin, and R. J. Kramer, III.
Separation Science and Technology, Vol 17, No 4, p 535-560, 1982. 11 Fig, 35 Ref.

Descriptors: *Coal, *Flotation, *Mine wastes, *Colloids, Bubbles, *Wastewater treatment, Surfactants, Wash water.

Colloid flotation was applied to removal of extremely small coal particles from wash water prior

to discharge into receiving waters. The process used micro-bubbles generated at low nitrogen gas flow rates. Oxidized coal particles had greater negative mobility and an isoelectric point at a lower pH than unoxidized coal. Hexadecyltrimethylammonium bromide (CTAB), a cationic surface collector, successfully adsorbed the negatively charged coal particles. Sodium lauryl sulfate, an anionic surfactant, was ineffective in flotation. At CTAB doses of 10 mg per liter and less, foaming was poor, especially at higher pH. At 25 mg per liter CTAB foam was stable at all pH. The pH, gas flow rate, and frother (ethanol) dose were varied to study the effects of these parameters on flotation. Rates of removal were greatest at low pH. At 60 min recoveries were 80-90% at pH 1.52 and 2.50, 20-25% at pH 5.35 and 8.50. At pH 3.50 an irregular removal pattern occurred, with eventual 90% removal. Foaming was maximum at pH 1.52 and 2.50, absent at 5.35 and 8.50, and slow to form at pH 3.50. Greater gas flow rates improved coal removal. Recovery was 100% in 20 min at 62 ml per min, 100% in 50 min at 31 ml per min, and 80% in 60 min at 16 ml per min. Varying the doses of frother showed that 100% removal was attained in 25 min at 1.71 ml per 400 ml coal suspension, in 50 min at 0.95 ml, and at > 80 min a 0.44 ml. No foam formed with 0.29 ml frother. (Cassar-FRC)
W82-05961

REMOVAL OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING MICROGAS DISPERSIONS,
Rhode Island Univ., Kingston.
S. Ciriello, S. M. Barnett, and F. J. DeLuise.
Separation Science and Technology, Vol 17, No 4, p 521-534, 1982. 7 Fig, 3 Tab, 12 Ref.

Descriptors: Metals, *Metal-finishing wastes, *Flotation, *Heavy metals, Chromium, Nickel, Copper, Lead, Zinc, Iron, *Wastewater treatment, Industrial wastewater, Bubbles, Chitosan, Chelation, Surfactants, Jewelry industry, *Microgas dispersions.

Batch flotation using microgas dispersions was used to remove heavy metals from individual solutions and from industrial plating effluents. Either ethylhexadecyldimethylammonium bromide or sodium dodecylbenzene sulfonate at 300 ppm was used to prepare the bubble structure. Removal was highest in the pH range 6-10, depending on the metal. Initial concentrations and % removals from individual solutions were; Cu, 8.46ppm, 100%; Ni, 19.50 ppm, 98.5%; Zn, 18.11 ppm, 95.1%;Cr, 10.10 ppm, 26.7% and Pb, 10.92 ppm, 79.1%. In a synthethic mixed metal wastewater containing about 10 ppm each of Cu, Ni, and Zn, 3.80 ppm of Cr, and 0.233 ppm Pb, removals were 95-98% for Cu, Ni, and Zn, 20.8% for Cr, and 100% for Pb. In a wastewater effluent from a plating plant with 0.1-2.6 ppm each, Cu, Ni, Fe, Cr, and Zn removals were 14.1-84.5%. Chitosan improved removals to 50.9-100% in another sample containing 0.2-3.9 ppm each of Cu, Ni, Fe, Cr, and Zn. Reducing hexavalent Cr to the trivalent state using sodium sulfite produced removal efficiencies of > 90% for all 5 metals tested (Cu, Cr, Ni, Zn, and Pb). (Cassar-FRC)
W82-05962

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, and W. G. Leseman.
Transactions of the ASAE, Vol 25, No 2, p 381-387, March/April, 1982. 9 Fig, 9 Tab, 15 Ref.

Descriptors: *Land application, *Wastewater irrigation, *Groundwater pollution, Fate of pollutants, Wastewater disposal, Land disposal, Municipal wastewater, Wastewater treatment, Tallahassee, *Florida, Nitrates, Soil disposal fields, Grasses, Nutrients, Hydrogen ion concentration, Potassium, Sodium, Calcium, Magnesium, Phosphorus.

Municipal wastewater effluent from the Tallahassee, Florida, treatment plant was applied to sandy soil planted to various grasses. The appplication was started in 1966. The characteristics of wastewater, soil, and groundwater were measured starting in 1971. Essentially all suspended soils, BOD, fecal bacteria, and phosphorous were removed by the soil. Water in a field well had an average pH of 7.7, 49 mg per liter chloride, and 18.6 mg per liter N (mostly nitrate) compared with the background well water of 8.3 pH, 2 mg per liter chloride, and < 1 mg per liter nitrate. The 31.3 mg per liter total N in the effluent was reduced to 1816 mg per liter by bacterial reduction and plant uptake. The coastal bermuda grass plot removed more N from the effluent than the plot with mixed vegetation. Ca passed through the soil unchanged. K was removed by the crop. Soil pH (5.8-6.3) was essentially constant with depth and intermediate between background soil of pH 5.5 and effluent of pH 7.5. The sum of extractable bases decreased with depth, exchangeable K and Na were constant with depth, and Ca and Mg decreased slightly with depth. At an irrigation rate of 20 cm per week, nitrate entered the groundwater, exceeding the drinking water standard of 10 mg per liter. (Cassar-FRC)
W82-05964

CARBON-DIOXIDE NEUTRALIZATION OF AN ALKALINE EFFLUENT,
Diamond Shamrock Corp., Muscle Shoals, AL.
M. J. Griffith, and D. B. Burgener.
Industrial Wastes, Vol 28, No 2, p 18, 24-45, March/April, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Neutralization, *Carbon dioxide, Design criteria, Effluent streams, Alkalinity, Industrial wastewater, Alabama.

A chloralkali plant in Muscle Shoals, Alabama, located on a 60 acre site adjacent to the Tennessee River has been converted from a manually controlled sulfuric acid pH control system for neutralizing the effluent to an automatic carbon dioxide process which is engineered to treat the caustic plant effluent before releasing it into the nearby river. The control system has allowed the plant to reduce the pH of 17 mgd of wastewater from a maximum of 11.75 down to 8.3, well within the 6.0 to 9.0 pH limits. This was done at lower cost than with a conventional acit treatment system. The availability of carbon dioxide, particularly during the winter months, was one factor influencing the decision, as the system had to operate continuously. The only disadvantage of using carbon dioxide is that it tends to lower the dissolved oxygen content to about 4.5% at the point of injection; this is not considered a problem in this application. The plant uses a unique sidestream pH control system to reduce the amount of carbon dioxide lost to the atmosphere by mixing a small volume of highly carbonated water with the remaining effluent flow. Since the pH is controlled with a supersaturated carbon dioxide-water solution, there is little of this gas being released from the discharge manifold into the effluent stream, and thus losses are negligible. The sidestream injection manifold is probably the simplest and most important component of the entire system. Extensive laboratory and on-site testing were performed to determine the direction, size and layout of the 20 removable orifices on the manifold. The system has performed in accordance with design parameters since its installation in 1978. (Baker-FRC)
W82-05973

COMMON FACILITY TREATMENT OF INDUSTRIAL WASTEWATERS,
Gulf Coast Waste Disposal Authority, Houston, TX.
J. P. Teller.
Industrial Wastes, Vol 28, No 2, p 26-28, March/April, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, Design criteria, Secondary wastewater treatment, Activated sludge process, *Texas.

The Gulf Coast Waste Disposal Authority concentrates on the disposal of wastewater, both municipal and industrial, and on the disposal of industrial solid wastes. The range of authority spans three counties, Chambers, Galveston, and Harris. Wastes from various sources are combined in different ways but treated at the same facility. In addition to industrial wastes the authority operates 26 municipal plants, seven of which are centralized for joint treatment. A case history of the Washburn Tunnel Facility is presented as an example of the process of developing a joint waste treatment program. The advantages of the joint approach to treatment include tax-free capital investment, ad-valorem tax exemption, sales tax-free purchases, savings in chemical costs, and the elimination of multiple laboratory functions. At the Washburn Tunnel Facility secondary treatment is provided for up to 52 mgd. This represents one-third of the industrial biological demand produced by Houston Ship Channel Industries. The activated sludge process removed 95% of the biochemical oxygen demand and 90% of suspended solids coming into the plant. Organic pollutants are brought into contact with bacteria and converted to harmless carbon dioxide, water and more bacteria. Regional waste treatment faciliies can work and yield a cost effective program for joint industrial waste treatment through careful planning and attention to detail. (Baker-FRC)
W82-05974

WASTEWATER TREATMENT AT AN ELECTRICAL GENERATION STATION,
Illinois Power Company, Decatur.
R. W. Walden.
Industrial Wastes, Vol 28, No 2, p 14-17, March/April, 1982. 1 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Electric power production, Hydroelectric power, Industrial wastes, Effluents, Water quality, Aeration, Chlorination, Ponds, Lagoons, Powerplants, *Illinois, Regulations.

The plan used by the Illinois Power Company in achieving compliance with water pollution control limitations revolves around the combining of various wastewater streams at coal burnign sites. For example, fly ash sluice waters and certain plant wastewaters have flocculation properties which aid in the cleanup of other wastewater streams when all are joined within the ash pond system. Other benefits of this approach include the operation of a complete water analysis laboratory, the minimum use of remote monitoring and control equipment needed for compliance, and the resulting cost effective installation, operation and maintenance methods associated with water pollution control efforts. The ash pond system was designed to include a majoy collection pond followed by two clarification ponds in series to control total suspended solids. A former sanitary treatment facility was replaced by an extended aeration system such that the sanitary effluent regularly satisfies the limits of 30 ppm for BOD-5, 30 ppm total suspended solids, 200 counts per 100 ml for fecal coliforms, 0.75 ppm for total chlorine residual and pH range of 6 to 9. The original units at the Havana Power Station, adjacent to the Illinois River system, have once-through river water cooling condensers. At the powerplant, a small portion of the low sulfur fly ash generated tends to float. Most of it is trapped in the first two ponds and appears as a white substance around pond shorelines. A carbon dioxide system has been installed for controlling ash pond pH during temporary excursions in plant operations. (Baker-FRC)
W82-05975

VERIFICATION OF A MODEL FOR FOAM FLOTATION COLUMN OPERATION,
Vanderbilt Univ., Nashville, TN.
J. E. Kiefer, J. Rodriguez, G. McIntyre, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 3, p 453-563, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Model studies, Surfactants, Effluents, Foam separation, *Wastewater treatment, *Foam flotation.

Experimental data were collected during testing of the validity of a mathematical model for the time-

dependent operation of a continuous flow floating column for industiral wastewater treatment. The surfactant being removed was sodium lauryl sulfate (NLS). A comparison was made of the responses of the column in steady-state operation and under the influence of rectangular pulses in terms of NLS concentration and of hydraulic loading rate with the results of computer simulation. Under all conditions effluent surfactant concentrations were well simulated. The fraction of liquid in the Plateau borders varied somewhat with the hydraulic loading rate, thus causing some discrepancy between calculated and observed collapsed foamate flow rates. It is noted that for a model which describes the column operation exactly, one must develop an expression for the fraction of liquid in the Plateau borders which depends on factors such as the total liquid fraction and the particulate concentration. Since effluent concentration is almost independent of this parameter, this expression is not needed to make the model useful as presented in this paper. Another addition which would improve the model would be to account for the mixing in the liquid pool below the air disperser. Such a change would allow one to predict more accurately the effluent concentration as a function of time as the influent conditions are abruptly changed. (Baker-FRC)
W82-06001

IMMOBILIZED MICROBES AND A HIGH-RATE, CONTINUOUS WASTE PROCESSOR FOR THE PRODUCTION OF HIGH BTU GAS AND THE REDUCTION OF POLLUTANTS,
Corning Glass Works, NY. Research and Development Labs.
R. A. Messing.
Biotechnology and Bioengineering, Vol 24, No 5, p 1115-1123, May, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Anaerobic digestion, *Methane bacteria, *Porous media, Ceramics, Wastewater treatment, *Biological treatment, Bacteria, Carbon dioxide.

A very efficient reactor for anaerobic digestion of sewage was based on microbes densely packed within the pores of controlled-pore ceramics. Some of the ceramic materials used were extruded Cordierite (pore diameter, 1-9 microns), Duralite Noire extruded brick (pore diameter 0.8-30 microns), and insulating firebrick (pore diameter 2-15 microns). Pore volumes were 0.29-1.0 cu cm per g. Laboratory-scale two-stage reactors consisted of the vertically mounted hydrolytic-redox stage, which reduced the size of the waste molecules (cellulose, protein), and the horizontally mounted anaerobic digestion stage, which converted the small molecules of carbon dioxide, acetic acid, etc. to methane. These reactors have operated continuously for 2 years, efficiently converting carbon to methane. The reactors were operated at 20, 30, and 40 C for residence times of 2-5.5 hours. Total COD of the sewage was 800-2600 mg per liter. 32-54% of the influent carbon was recovered as methane, and total COD reduction was 63-89%. The resulting gas was 90% methane and < 5% CO2. (Cassar-FRC)
W82-06005

MODIFIED SLUDGE DIGESTION WITH IMPROVED GAS YIELD (MODIFIZIERTE SCHLAMMFAULUNG MIT VERBESSERTER GASAUSBEUTE).
Wasser, Luft und Betrieb, Vol 26, No 1/2, p 24-25, 1982. 1 Fig. (No English summary).

Descriptors: *Sludge digestion, *Anaerobic digestion, *Energy conversion, Heat exchangers, *Wastewater treatment, Biodegradation, Biological treatment, Costs, Pendulum mixer, Zenith-Biomax system.

A modified system of anaerobic alkaline sludge digestion, the Zenith Biomax, is described. The system seeks to reduce energy costs as well as investment and maintenance costs and allows for the addition of prepasteurization capabilities. The heat supply is built exclusively on external heat-exchanger systems. The system is equipped to allow loading of fresh sludge to correspond to energy demand, resulting in maximal energy yield. The Biomax system is also capable of enabling the user to calculate energy demand in advance. A special method of turning the digestion tank, which is highly significant with regard to gas yield and digestion time, was developed: the Zenith pendulum mixer. This provides a settling and thickening zone in the bottom area of the digestion tank. Through the centrifugal effect in the turning zone the sedimentation of mineralized substances is markedly improved, and the proportion of mineralized substances in the end product greater. A further advantage of the pendulum mixer is that movement in the main sluice runs from bottom to top. This must be reversed occasionally for technical reasons, and the dual tangential outflow results in rotation of the tank. This effect is used in the separation of floating sludge, which can be done several times daily without significantly impairing gas production. An optimal bacterial culture in the upper area of the tank and easier gas extraction is also achieved by using the pendulum mixer. The Biomax system can improve gas yield by up to 30%. Further utilization of this gas will be economically feasible in larger plants. (Gish-FRC)
W82-06024

DOMES, BUBBLES, AND PAPER WASTE,
Badger Paper Mills, Inc., Peshtigo, WI.
R. Kinzel, and H. Rushton.
Water/Engineering and Management, Vol 129, No 4, p 47-48, April, 1982.

Descriptors: *Pulp and paper industry, Aeration, *Bubbles, *Wastewater treatment, Industrial wastewater, Badger Paper Mills, Peshtigo, Wisconsin, Activated sludge process.

The Badger Paper Mills, Inc., built a 6 mgd wastewater treatment plant for joint use by the mill and the town of Peshtigo, Wisconsin. This system replaced a mechanically aerated 2-lagoon plant. The new treatment plant incorporated a dome diffusion aeration system, which generates fine bubbles from porous ceramic diffuser domes equally spaced on the floors of the concrete basins. The plant receives 95% of its waste load from the paper mill and 5% from municipal sources. Power costs have been reduced 35-40% and detention time by 14 days compared with the lagoon system. The concrete basins required only one-fourth the land area taken by the lagoons. Splashing, spray cooling, and winter freezing, frequently problems in the lagoon operation, have been eliminted. Sludge is more easily dewatered. (Cassar-FRC)
W82-06025

REMOVAL OF HEAVY METALS FROM ELECTROPLATING RINSEWATERS BY PRECIPITATION, FLOCCULATION AND ULTRAFILTRATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and J. T. Delwiche.
Water Research, Vol 16, No 5, p 729-737, May, 1982. 6 Fig, 8 Tab, 15 Ref.

Descriptors: Metals, *Electroplating, Industrial wastewater, *Wastewater treatment, Metal-finishing wastes, *Heavy metal, Chemical precipitation, *Flocculation, *Filtration, *Ultrafiltration, Chromium, Copper, Zinc, Nickel, Cyanides, Sodium hydroxide, Iron compounds.

Heavy metals were effectively removed from four separate electroplating rinsewaters by precipitation, flocculation, and ultrafiltration. Hexavalent Cr was first reduced to the trivalent state with ferrous sulfate and then precipitated with NaOH. Ni rinsewaters were treated with NaOH and FeC13 and again with NaOH. Cyanides in Cu and Zn rinsewaters were oxidized with NaOCl before precipitation of the hydroxides with FeCl3 and NaOH. Filtration through a plate-and-frame ultrafiltration apparatus with acrylic membranes of 0.20-.80 micron pore size reduce the effluent metal concentrations (mg per liter) to 0.17 (trivalent Cr), 0.26 (Ni), 0.30 (Cu), and 1.84 (Zn). Water recoveries (the fraction of the feed stream that permeates the membrane) were: Ni,24%; Cr. 10%; Cu, 6.5% and Zn, 3.7%. High water recoveries were associated with the maximum volume of filtered water in a given time and at a given pumping power. The metal levels were in good agreement with theoretical solubility curves, except for Cu, where the formation of stable Cu cyanide complexes appears to increase the solubility by 2 orders of magnitude over the solubility predicted from equilibrium constants for copper hydroxides and oxides. (Cassar-FRC)
W82-06029

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06030

EFFECT OF CHEMICAL COAGULATION ON ANAEROBIC DIGESTIBILITY OF ORGANIC MATERIALS,
Cornell Univ., Ithaca, NY. Dept of Environmental Engineering.
S. K. Dentel, and J. M. Gossett.
Water Research, Vol 16, No 5, p 707-718, May, 1982. 14 Fig, 5 Tab, 36 Ref.

Descriptors: *Sludge digestion, *Coagulation, *Organic matter, *Wastewater treatment, Digestion, Alum, Ferric chloride, Anaerobic digestion, Proteins, Carbohydrates, Acids, Organic acids, Amino acids, Chemical reactions, Phosphates, Biodegradation.

Chemical coagulation of wastewater with alum or ferric chloride reduced the biodegradability of sludges in anaerobic digestion. This paper investigated different substrates: raw wastewater, activated sludge, three proteins (gluten, ovalbumin, and zein), glycine, cellulose, glucose, butyric acid, and palmitic acid. In general, the sludges from the less water-soluble substrates and the substrates containing readily ionizable groups were most adversely affected. This group included amino acids, proteins, and long chain fatty acids, but not glucose and butyric acids. Cellulose was moderately affected, suggesting that physical enmeshment may be a factor. The observed coagultion effects were distinct from any effects of increased loading or differences in pH or alkalinity and were not attributable to toxicity, increased fixed solids concentrations, or phosphate limitation. Smaller particles were less easily digested than larger, settleable particles. During the flocculation process the organic substrate is enmeshed in the floc, rendering it less susceptible to digestion. Chemical interactions also may affect digestibility. (Cassar-FRC)
W82-06039

PRODUCT INHIBITION IN THE ACID FORMING STAGE OF THE ANAEROBIC DIGESTION PROCESS,
Amsterdam Univ. (Netherlands).
R. J. Zoetemeyer, A. J. C. M. Matthijsen, A. Cohen, and C. Boelhouwer.
Water Research, Vol 16, No 5, p 633-639, May, 1982. 5 Fig, 8 Tab, 19 Ref.

Descriptors: *Anaerobic digestion, *Inhibition, *Acids, *Wastewater treatment, Volatile acids, Butyric acid, Organic acids, Fatty acids, Organic compounds, Glucose, Nutrients, Kinetics, Chemical reactions, Biodegradation, Sulfates, Carbonhydrates.

Inhibition of the anaerobic digestion process by formation of volatile fatty acids was studied using glucose as a carbon source and a complete nutrient medium to ensure carbon limitation. Glucose monohydrate concentrations were 2.5, 5, 10, 30, 50, and 75 g per liter. The main products (butyrate, acetate, and lactate) increased with increasing glucose concentrations; ethanol and propionate were fairly constant; formate was < 10 ppm C. Product recoveries averaged 90%. Yields decreased from 16-19% at lower concentrations to 9-10% at higher glucose concentrations. Maximum dilution rates

changed from 0.46 at the lowest glucose concentrations to 0.04 at the highest. A relationship was observed between maximum dilution rate and log of concentration of acids produced. At a constant glucose input concentration of 10 g per liter inorganic nutrients were increased from 1 to 5%. No reaction inhibition occurred during gradual nutrient increases, but sudden large changes caused reactor failure. Sulfate reduced to sulfide at sulfate concentrations > 140 ppm, but no inhibition was noted. Addition of 1100 mg C per liter butyrate to the reactor decreased butyrate and propionate production and increased lactate production. At higher butyrate influent levels, glucose appeared in the effluent, a small amount at 1700 mg C per liter butyrate dose and large amounts at 2500 mg C per liter. The reactor returned to a steady state after 3 days. (Cassar-FRC)
W82-06041

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
L. Brown, M. M. Rhead, D. Hill, and K. C. C. Bancroft.
Water Research, Vol 16, No 5, p 579-591, May, 1982. 1 Fig, 9 Tab, 20 Ref.

Descriptors: *Acrylamide, *Organic compounds, *Toxicity, Water pollution effects, Fate of pollutants, Activated sludge process, Biological treatment, Invertebrates, Aquatic fauna, Insects, Species diversity, Acclimatization, Wastewater treatment, Biodegradation, Degradation, Adsorption.

Acrylamide, a toxic monomer, was added to an activated sludge sewage works, a biological filter sewage works, and a river during the period October 1979 to July 1980. Little in situ degradation of acrylamide occurred in the primary or final settlement tanks in either sewage plant. However, the high microbial activity in the activated sludge tanks and in the biological filter beds reduced the acrylamide by 50-70%. In another study acrylamide was dosed into a stream for 74 days. No in situ loss of acrylamide by degradation or adsorption occurred within 4-5 hours. There was an apparent slight increase in degradative ability of the micro-organisms with long-term exposure to acrylamide. The insect fauna in the river showed reduced species diversity and population size within 5 hours of dosing to 50 micrograms per liter acrylamide. After a week's exposure only Hydropsche instabilis did not suffer adverse effects or total elimination. Several species recolonized within 4 to 8 weeks after the final acrylamide dose. (Cassar-FRC)
W82-06044

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,
Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, J. A. Veil, and J. T. Canaday.
Water Research, Vol 16, No 5, p 543-550, May, 1982. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Microscopic analysis, *Microorganisms, *Biological treatment, *Wastewater treatment, *Rotating biological contactors, Bacteria, Beggiatoa, Desulfovibrio, Biofilms, Sulfides, Sulfur bacteria, Filamentous bacteria, Heterotrophic bacteria, Anaerobic bacteria, Aerobic bacteria.

A rotating biological contactor biofilm from a treatment facility in Alexandria, Virginia, was examined by scanning electron microscope to characterize the nature of filamentous surface growth. Layers of morphologically diverse microorganisms were found. The white surface layer was composed of a dense interwoven mat of bacterial filaments, dominated by Beggiatoa . The black lower layer contained straight and comma-shaped rods dominated by Desulfovibrio, a sulfide producing bacteria. The black color is believed to be a ferrous sulfide deposit. The sulfide diffuses toward the surface layer and serves as an energy source for the Beggiatoa. The filamentous growth is a symptom of reduced oxygen availablility and high substrate loadings. (Cassar-FRC)
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
R. J. Larson, and S. L. Schaeffer.
Water Research, Vol 16, No 5, p 675-680, May, 1982. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Activated sludge process, *Toxicity, *Inhibition, Wastewater treatment, Water pollution effects, Mercury, Sodium azide, Hypochlorites, Dichlorophenol, Phenols, Trimethylammonium chloride, Organic compounds, Sodium hypochlorite.

Toxicity of chemicals to activated sludge was determined by measuring inhibition of C14-labeled glucose uptake after 15 min. The IC50 value (the concentration of chemical inhibiting uptake by 50%) was determined by nonlinear regression analysis of the decrease in glucose uptake as a function of the log of test chemical concentration. Uptake in the presence of both inorganic and organic chemicals showed significant dose-dependent decreases as the concentration of test material increased. Some IC50 values (in mg per liter) were: 3,5-dichlorophenol, 13.4; alkyl trimethyl ammonium chloride, chain length, C14-C18, 28.4; hypochlorite, 20.0; and sodium azide, 1041.8 (essentially nontoxic to sludge). IC50 for Hg(++) depended on the level of volatile suspended solids, decreasing from 6.1 to 1.6 mg per liter with a four-fold dilution. The results obtained in this study agreed with values from previous studies on materials which adversely affect wastewater treatment processes. (Cassar-FRC)
W82-06048

EFFECT OF MAGNESIUM AND CALCIUM PRECIPITATION ON COAGULATION-FLOCCULATION WITH LIME,
Ministry of Transport and Public Work, Middelburg (Netherlands). Environmental Research Div.
J. Leentvaar, and M. Rebhun.
Water Research, Vol 16, No 5, p 655-662, May, 1982. 10 Fig, 5 Tab, 10 Ref.

Descriptors: *Lime, *Magnesium hydroxide, *Coagulation *Wastewater treatment, *Calcium hydroxide, Chemical precipitation, Flocculation, Adsorption, Organic matter, Organic carbon.

Two major mechanisms were demonstrated in coagulation-flocculation of sewage with lime-magnesium hydroxide treatment: (1) sweep coagulation by calcium carbonate and (2) adsorption-coagulation of stable organic colloids by magnesium hydroxide. On the average, 45% of total organic carbon (TOC) and 85% of light absorbing matter were removed by calcium carbonate precipitation. An additional 16% TOC and 7% of light absorbing matter were removed by magnesium hydroxide, leaving a non-removable fraction of 39% of TOC and 8% of light absorbing matter. The relationship between TOC or light absorbing matter removal and magnesium hydroxide precipitation was expressed as an adsorption isotherm similar to a Freundlich adsorption isotherm. Maximum adsorption capacity was 1.5-3.0 mg TOC per mg Mg. (Cassar-FRC)
W82-06053

ALGAL GROWTH IN PRIMARY SETTLED SEWAGE--THE EFFECTS OF FIVE KEY VARIABLES,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
S. Y. Ip, J. S. Bridger, C. T. Chin, W. R. B. Martin, and W. G. C. Raper.
Water Research, Vol 16, No 5, p 621-632, May, 1982. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Algal growth, *Wastewater lagoons, *Wastewater treatment, Photoperiodism, Temperature effects, Carbon dioxide, Nitrogen removal, Phosphorus removal, Biomass, Bicarbonates, Nitrates, Ammonium nitrate, Cyanophyta, Chlorophyta, Algae harvesting, Productivity.

The effects of photoperiod, temperature, carbon dioxide, bicarbonate, and nitrogen on algal growth in wastewater ponds were investigated in bench scale experiments at high and low levels for each factor. High and low levels were: photoperiod, 12 and 6 hours; temperature, 30 and 15 C; carbon dioxide, 1% and 0.03%; bicarbonate, 100 mg per liter NaHCO3 added and sewage as received; and nitrogen, 30 mg per liter ammonium nitrate added and sewage as received. Domestic sewage from a Melbourne suburb was used. Photoperiod at 3240 1x light intensity was the primary limiting factor on algal growth. At a retention time of 7 days, a total effective photoperiod of > 6 hours per day was required to produce algae at concentrations above 500 mg per liter. Increasing dissolved carbon dioxide levels encouraged production of green algae, which were unicellular and hard to harvest. The lower level of CO2 favored the more gelatinous and filamentous blue-green algae. Low temperature (15 C) promoted algal growth by increasing CO2 solubility. Algal production was increased by addition of carbonate and was decreased by addition of excess ammonium nitrate. In this experiment nitrogen removal was 3 mg per 100 mg biomass produced; phosphorus removal was 0.5 mg per 100 mg biomass produced. (Cassar-FRC)
W82-06055

ENERGY CONSERVATION IN MUNICIPAL WASTEWATER PLANTS,
New York State Energy Office, Albany.
E. R. Bogardus.
Clearwaters, Vol 12, No 1, p 10, 11-14, March, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Municipal wastewater, *Energy conservation, Wastewater treatment, Cost analysis, Economic aspects, Anaerobic digestion, Maintenance, Training.

The role of the New York State Energy Office in the development and coordination of an overall state energy program is discussed. Results of a recently completed Energy Office study on eleven New York State wastewater plants wasting digester gas are presented. Plans for the 1982 Energy Office wastewater program are detailed. The State Energy Master Plan provides the framework for energy decisions throughout the State. Conservation is the cornerstone for the energy plans. New York has been disproportionately affected by events related to escalating petroleum prices and supply shortages. While New York is the sixth largest energy user among all the states, only 9.5% of the total demand is satisfied from resources produced within the state. The Energy Office conservation program focuses on existing wastewater treatment facilities. Process reliability has been linked in the past to the high use and ready availability of energy for pumping, compressing air, and handling sludge. The key to the successful operation of an anaerobic digester is to maintain proper environmental conditions so that a balance exists between the acid-forming and the methane-forming bacteria. Vital to energy conservation and production is increased wastewater operator training, as these individuals are the key to a program's success or failure. The Energy Office expects the shift from site-specific activity to broad-based information dissemination to help meet this need. (Baker-FRC)
W82-06070

NEW DIRECTIONS IN WATER POLLUTION CONTROL,
Environmental Protection Agency, New York. Region II.
For primary bibliographic entry see Field 5G.
W82-06071

WATER TREATMENT BY AQUATIC ECOSYSTEM: NUTRIENT REMOVAL RESERVOIRS AND FLOODED FIELDS,
Florida Univ., Sanford. Agricultural Research and Education Center.
K. R. Reddy, P. D. Sacco, D. A. Graetz, K. L. Campbell, and L. R. Sinclair.
Environmental Management, Vol 6, No 3, p 261-271, 1982. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Nutrient removal, *Water treatment, Nitrogen, Phosphorus, Phosphates, Aquatic plants, Storage ponds, Ponds, Reservoirs, Wastewater treatment.

An evaluation was made of the potential use of reservoirs and flooded fields stocked with aquatic plants for reducing the nutrient levels of organic soil drainage water. Treatment systems included: a large single reservoir stocked with waterhyacinth, elodea, and cattails (R1); three small reservoirs in series with waterhyacinth, elodea, and cattails grown in independent reservoirs R2, R3, and R4, respectively; a control reservoir (R5) with no cultivated plants; a large single flooded field planted to cattails; three small flooded fields in a series planted to cattails; and a flooded field with no cultivated plants. Drainage water was pumped daily into these systems for 27 months. Water samples were collected at the inlet and outlet of each treatment system and analyzed for nitrogen and phosphorus forms. The series of reservoirs stocked with aquatic plants functioned effectively in the removal of N and P from agricultural drainage water, compared to a single large reservoir. Allowing the water to flow through the reservoir stocked with waterhyacinth plants with a residence time of 3.6 days was adequate to remove about 50% of the incoming inorganic nitrogen. Allowing water to flow through a series of two small reservoirs with a residence time of 7.3 days was needed to remove about 60% of the incoming orthophosphates. Flooded fields were effective in the removal of inorganic nitrogen, but showed poor efficiency in the removal of ortho-phosphates. (Baker-FRC)
W82-06078

COMPARISON OF THE EXTRACTABILITIES OF ZN, CU, NI AND CR FROM SEWAGE SLUDGES PREPARED BY TREATING RAW SEWAGE WITH THE METAL SALTS BEFORE OR AFTER ANAEROBIC DIGESTION,
Rothamsted Experimental Station, Harpenden (England).
C. Bloomfield, and S. P. McGrath.
Environmental Pollution, Vol 3, No 3, p 193-198, 1982. 1 Fig, 2 Tab, 14 Ref.

Descriptors: Metals, *Anaerobic digestion, Sludge, *Nickel, *Copper, *Chromium, *Zinc, Wastewater treatment, Extraction techniques.

The extractabilities of zinc, copper, nickel and chromium from sludge prepared by anaerobic digestion of relatively uncontaminated raw sewage was compared in the presence of salts of the metals with those from sludge prepared from the same batch of raw sewage and equilibrated with the metals subsequent to anaerobic digestion. The digestion and sorption metal treatments enriched the sludge to roughly the same extents. Such differences as there were probably resulted from the heterogeneity of the original sewage and the consequent unequal amounts of dry matter in the various batches. Neither the digestion nor the sorption treatments had any sifnificant effect on the total contents of the metals native to the original sewage, although it is possible that the nickel sorption treatment may have displaced some zinc. All three extractants removed metals sorbed on predigested sludge more readily than those incorporated during the digestion process. Barely significant amounts of zinc, copper or chromium, either native or applied, were extracted by neutral ammonium acetate from sludge formed in the presence of the metals, but nearly 26% of the added nickel was removed by this reagent. Only slightly more nickel was extracted from the sorption product, but ammonium acetate removed between 7 and 8 times as much sorbed as digested zinc and copper. The amounts of chromium extracted by ammonium acetate from the two preparations did not differ significantly. Similarly the availabilities of the metals as determined by extraction with acetic acid or EDTA were considerably less in sludge formed by digestion in the presence of the metals than in sludge obtained by treatment with the salts subsequent to the digestion process. (Baker-FRC)
W82-06079

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,
Ben-Gurion Univ. of the Negev, Geersheba (Israel).
For primary bibliographic entry see Field 5A.
W82-06117

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,
Ben-Gurion Univ. of the Negev, Beersheba (Israel).
For primary bibliographic entry see Field 3A.
W82-06118

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
Ali M. El-Nashar.
Desalination, Vol 33, No 1, p 21-48, April, 1980. 18 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Membranes, Energy conservation, Water conservation, Membrane processes, *Recycling, Water reuse.

Textile dyeing operations consume large amounts of process water and thermal energy. The wastewater resulting from these operations contains various types of contaminants of organic and inorganic origin. This wastewater has an above average temperature. The possibility of renovating and recycling a major portion of this wastewater would reduce the water and energy consumption by these dyeing operations. This paper presents pilot plant test results using Zr(IV)-PAA dynamic RO membrane modules for treating dyeing wastewater. Using these results, a mathematical model was presented to evaluate the design parameters and economic feasibility of a 1000m3/day plant for treating and recyclig dyeing wastewater. The economic results show that a net profit could be obtained by recycling product water. (Balaban-Boston)
W82-06123

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, C. H. Dean, R. R. Jacobs, M. E. Knuckles, and R. E. Wagner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243650, Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report No 168 (UNC-WRRI-81-168), June 1981. 39 p, 1 Fig, 15 Tab, 25 Ref. OWRT A-090-NC(6), 14-34-0001-7070.

Descriptors: *Enteroviruses, *Wastewater treatment, *Soil types, *Soil absorption capacity, *Wastewater treatment, Path of pollutants, Viruses, Soil chemistry, Soil saturation, Clays, Organic soils, Sand, Sorption, Retention, Retention capacity, Adsorption, Adsorbents, Soil treatment systems.

Laboratory and pilot-scale studies were carried out on the interactions and survival of representatives of two different enteric virus groups (poliovirus type 1 and reovirus type 3) in 11 different soil materials in settled sewage. Three were marked differences in the abilities of the soil materials to remove/retain viruses from the sewage, but for each soil material the behavior of the two viruses was often similar. Virus absorption to soils was rapid, mostly occurring in 15 minutes. Clayey materials effectively absorbed both viruses from wastewater over a range of pH and total dissolved solids (TDS). Sands and organic soils were relatively poor sorbents, but, in some cases, their viral sorption ability increased at low pH and with the addition of TDS or divalent cations. In pilot-scale studies with 5-foot long columns (3-foot unsaturated upper zones; 2-foot, saturated bottom zones), extensive reductions of the two viruses occurred when septic tank effluent (30,000-60,000 viral plaque-forming units/ml) was applied at 1.3 inches/day over 8-week periods; no viruses were detected in extracts from the column soil materials that had relatively poor virus sorbent capabilities. It appears that extensive virus reduction can occur in such soils when there is sufficient depth of unsaturated flow; the effects of periodic rainfall, however, must be further investigated. (Zielinski-MAXIMA)
W82-06150

AUTOMATION AT NORWICH SEWAGE-TREATMENT WORK: FIVE YEARS' EXPERIENCE,
Anglian Water Authority (England).
P. Cotton.
Water Pollution Control, Vol 80, No 2, p 243-259, 1981. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Wastewater facilities, *Computers, Planning, Design criteria, Water Treatment facilities, *Norwich, Great Britain.

The Norwich sewage treatment works of the Anglian Water Authority is described. The works serves the City of Norwich and surrounding districts, and has a design DWF of 55 tcmd derived from a contributing population of 200,000 since undergoing extensions between 1973 and 1975. Preliminary treatment comprises rotary-cup screens, disintegrators and detritors. After separation of storm sewage at about 3 DWF, sewage is proportioned between two plants operating in parallel. One comprises primary sedimentation tanks , bioligical filters and humus tanks, and the other primary sedimentation tanks, diffused-air activated-sludge plant and secondary settlement tanks. Sludge treatment is also effected through two paralled plants, one comprising consolidation tanks, primary heated anaerobic digestion tanks, and open secondary digestion tanks, and the other, storage tanks and the pressure-filtration plant. Plant operations are monitored and controlled from the central control room, where the operator communicates with the computer system via the operator control panel and the logging printer. Cost analysis information is included. (Baker-FRC)
W82-06157

APPROPRIATE SELECTION OF WATER/WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,
Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, A. Law, and T. Chaudhry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254889, Price codes: A05 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Stillwater, Report, March 1982. 78 p, 2 Fig, 11 Tab, 15 Ref, 5 Append. OWRT A-100-OKLA(1), 14-34-0001-1138.

Descriptors: *Rural areas, *Computer models, *Water treatment, *Wastewater treatment, *Water quality control, Mathematical models, Model studies, Computer programs, Mathematical studies, Social participation, Public participation, Water use, Water supply development, Water pollution control, Water pollution prevention, Project planning, Planning, Alternative planning, Water quality, *Wastewater facilities.

Small communities often have to resort to usage of highly inappropriate and sophisticated systems that are difficult to operate and maintain with regard to their water supply and sanitation needs. A computer application model is presented that will aid engineers/planners in determining a community's needs and resources. Two versions of this model

were developed: one, for use on a low-cost microcomputer; the other, for use with a hand-held calculator. Both of these versions consider the socio-technological level of the community, as well as indigenous information covering water quality and demographic data. Four communities in the rural and urban fringe in Oklahoma were selected for testing the validity of this model. The model identifies water and waste treatment alternatives which are compatible with local available resources and manpower capabilities; application of appropriate technology substantially enhances the ability of the community to satisfy its water and wastewater treatment objectives. Community information was obtained from the use of two survey questionaires to assist identification of appropriate technology for water/wastewater treatment. (Zielinski-MAXIMA)
W82-06162

APPARATUS FOR HIGH-EFFICIENT MICROBIOLOGICAL OXIDATION TREATMENT,
Hitachi Ltd. (Japan). (Assignee).
N. Shimizu, Y. Odawara, T. Yamaguchi, S. Saitou, and A. Nakaoka.
U.S. Patent No 4,203,841, 8 p, 5 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 986-987, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Organic wastes, Aeration, Activated sludge, Oxygen, Equipment, Bacteria, Oxygen demand, Oxidation, *Biological oxidation, Oxygen transfer rate.

Waste water containing organic materials is introduced into an aeration tank, and is subjected to aeration treatment in the presence of activated sludge, while supplying oxygen to the aeration tank. The tank is provided with an air diffusion pipe at the bottom of the tank, an air dispersion device above the air diffusion pipe and a number of inside cylinders above the air dispersion device. An overall circulating stream and partial circulating streams are generated in the aeration tank. (Sinha-OEIS)
W82-06166

FACTORS AFFECTING FLOG FORMATION AND BULKING IN THE ACTIVATED SLUDGE PROCESS FOR TREATMENT OF TEXTILE WASTE WATERS,
Auburn Univ., AL. Dept. of Botany, Plant Pathology, and Microbiology.
W. T. Blevins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254954, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 23 p, 1 Fig, 4 Tab, 3 Ref. OWRT A-073-ALA(1), 14-34-0001.

Descriptors: *Textile mill wastes, *Microbiological studies, *Activated sludge, *Sludge volume index, Industrial wastes, Solid wastes, Microorganisms, Microscopic analysis, Microscopy, Bacterial analysis, Bacteria, Sewage bacteria, Sodium, Sludge, Sludge disposal, *Wastewater treatment.

A textile and municipal wastes activated-sludge facility was studied microbiologically during normal sludge settling/bulking periods, and factors influencing the degree of microbial flocculation and effluent quality were examined. Total viable numbers of bacteria were determined, and isolates were taxonomically characterized. A filamementous bacterium (resembling Eikelboom's Type 0961, known to predominate some activated-sludge reactors with low food/microorganism ratios) was the most prevalent in bulking sludge. Prevalent genera indicated relative stability in the community population structure at this facility. Predominant bacteria were species of Acinetobacter, Alcaligenes, Pseudomones, and Flavobacterium. All bacteria isolates flocculated well in synthetiuc media and/or sterilized wastewaters. Unusually high COD/BOD ratios suggested an effluent of chemically low quality, and the dominance of small flagellates (Bodo sp. and Notoselenus sp.) implicated a resultant low quality effluent. Temperatures of 20-25 degrees and pH 8.5 support optimal settleability and lowest sludge volume index values. High sodium ion levels from the textile mill dramatically affected settleability, which improves with increasing divalent cation levels. (Zielinski-MAXIMA)
W82-06171

ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,
Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
D. D. Ellis, C. M. Jone, R. A. Larson, and D. J. Schaeffer.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 373-382, 1982. 4 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Mutagens, *Organic compounds, *Effluents, Pollutant identification, Carcinogens, *Secondary wastewater, Priority pollutants, Hydrocarbons, Aromatic compounds, Phenols, Fatty acids, Chlorinated compounds, Nitrogen compounds, Pesticides, Phthalates.

Samples of mutagenically active effluents from Illinois industrial and municipal wastewater treatment plants were analyzed by capillary gas chromatography/mass spectroscopy. A total of 243 organic compounds were tentatively identified. Twenty of these were priority pollutants, and 33 were not previously detected in water samples. Among the compounds found wre hydrocarbons (straight chain, aromtic, and polyaromatic), phenols, alcohols, terpenes, ketones, aldehydes, organic acids and esters (including fatty acids and fats), plasticizers, ethers, halogenated compounds, nitrogen compouns (pyridines, anilines, etc.) and pesticides. The only known carcinogenic or mutagenic materials were N-nitrosodimethylamine and o-toluidine. However, most of the compounds detected in the effluents have not been tested for genetic activity. It is also possible that active mutagens may be present but undetected by the method of analysis used. (Cassar-FRC)
W82-06178

WATER POLLUTION CONTROL PLANT UPGRADED TO MEET EPA REGS.
Civil Engineering (New York), Vol 52, No 6, p 56-57, June, 1982.

Descriptors: *Water treatment facilities, *Water pollution control, Regulations, design criteria, Philadelphia, Energy conservation, Delaware River, Water quality, River basins, Computers, Automation, Wastewater treatment, Industrial waste, Municipal waste.

A $300 million addition was made to the Southwest Water Pollution Control Plant in Philadelphia which nearly doubles the plant capacity to 210 mgd. Plant operators were consulted extensively during the design, and considerable time was spent converting operating experiences into engineering data and plans. One outcome was a computerized control system. To expedite the treatment process, the plant uses pure oxygen rather than air. The plant produces its own oxygen by using a cryogenic fractional distillation oxygen unit. Since construction took place during normal plant operation, special techniques were used to keep the process going. The waste gas is collected at low pressure from the sludge digestion tanks and is compressed by two 125-horsepower rotary gas compressors for distribution throughout the plant. Sludge gas is used for sludge heating, space heating, scum incineration and grit incineration. (Baker-FRC)
W82-06187

THE INFLUENCE OF TRANSIENT TEMPERATURE CHANGES ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
L. A. Obeng, R. Perry, and J. N. Lester.
Environmental Pollution, Series A, Vol 28, No 2, p 149-161, 1982. 8 Fig, 1 Tab, 35 Ref.

Descriptors: *Activated sludge process, *Temperature effects, Sludge, Metals, Biodegradation, Cadmium, Lead, Zinc, Copper, Heavy metals, *Wastewater treatment, *Nitrilotriacetic acid, Detergents.

Experiments were performed to determine the effects of transient reductions in temperature to values of about 12 degrees C and values of less than 10 degrees C on the biodegradation of NTA (nitrilotriacetic acid) and any consequent effects on effluent metal concentrations. To determine the effect of transient reductions in temperature, four experiments were undertaken. In each experiment two activated sludge simulations were subjected to an identical temperature shock. The two were in a comparable condition prior to treatment, except that the influent to one contained 10 mg/liter of NTA, which was being consistently biodegraded. Two temperature shocks were examined, first from 17.5 to 12.5 degrees C over 4 hr. remaining at that temperature for 8 hr, and second, from 17.5 to 9.5 degrees C in 8 hr, remaining there for 6 hr before returning to 17.5 during the following 10 hr. The results demonstrate that there were no adverse effects on the biodegradation of NTA and no effect on effluent metal concentrations when the temperature was decreased from 17.5 to 12.5 degrees C. However, a drop from 17.5 to about 9.5 resulted in incomplete biodegradation of NTA and an associated increase in effluent concentrations of cadmium, copper, lead, and zinc. These effects were reversed as the temperature was allowed to return to 17.5 degrees C. (Baker-FRC)
W82-06193

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,
North Dakota State Univ., Fargo. Dept. of Bacteriology.
K. R. Mitchell, and B. R. Funke.
Environmental Pollution, Series A, Vol 28, No 2, p 81-88, 1982. 4 Tab, 20 Ref. OWRT A-057-NDAK.

Descriptors: *Bacteria, *Food-processing industry, Flumes, *Industrial wastes, *Food-processing wastes, Wastewater, Coliforms, Salmonella, Fecal bacteria, Beets, Spray irrigation, *Enteric bacteria.

Refinery processing waters at the Red River Valley and Minnesota sugarbeet processing plants were examined for enteric bacteria. At the Hillsboro, North Dakota sugarbeet refining plant the processing waters are circulated in a closed system. Water used in the flume and washer is obtained from a freshwater reservoir and, after use, is pumped through a clarifier to remove settleable solids and returned for reuse. During processing additional water accumulates from the beet. Lime is used during sugar purification and enters the wastewater stream through the clarifier. Underflow containing settleable solids from the clarifier is pumped into the lime mud pond. Water from this pond can then be pumped to a sequence of small lagoons, then through an activated sludge treatment system into the freshwater reservoir for reuse. When the reservoir is full, water is transferred into an irrigation lagoon for eventual disposal by spray irrigation. All of the tested processing waters were positive for Salmonella at least once. The soil adhering to beets was tested for Salmonella and fecal coliforms, and substantial numbers were found in some samples. While determining the source of the problem was not part of the study, all of the farmers from whose land Salmonella-containing sugarbeet originated were contacted and denied use of animal manures on their land. Samples of alfalfa grown on the irrigated plot showed no Salmonellae or fecal coliforms. Concern for aerosol transmission of Salmonella in the spray irrigation process is voiced. At present the presence of Salmonella and fecal coliforms in sugar beet refining processing waters does not appear to represent a public health hazard in relation to their disposal by spray irrigation. However, the Salmonella populations found in the early part of the processing season in flume waters, in excess of one million per 100 ml, could be a hazard for workers coming in contact with flume waters. (Baker-FRC)
W82-06195

ELIMINATION OF ODOR FROM ANAEROBIC LAGOONS,
Greeley Dept. of Public Works and Utilities, CO.
C. W. Hargett, Jr., and M. H. Rybus.
Public Works, Vol 113, No 5, p 82-83, May, 1982. 1 Fig.

Descriptors: *Odor control, *Lagoons, *Meat processing industry, *Anaerobic lagoons, Wastewater lagoons, *Wastewater treatment, Greeley, *Colorado, Biological oxygen demand, Aeration, Scum.

An anaerobic lagoon system treating meat packing plant wastes in Greely, Colorado, had persistent odor problems since its startup in 1973. Methods of odor control which were ineffective included channeling flow to only one lagoon of the four, aeration on the surface, pouring gasoline on the surface and igniting it, adding grease to improve the quality of the scum blanket, and deodorant spraying. The odor problem was eventually overcome by using heavy organic loadings (12 pounds BOD per 1000 cu ft of water) and loading one lagoon at a time to form a thick and strong scum blanket to prevent odors from escaping. (Cassar-FRC)
W82-06221

TREATMENT OF PULP AND PAPER INDUSTRY WASTEWATERS IN AN ANAEROBIC FLUIDIZED BED REACTOR,
Enso-Guzeit Osakeyhtio, Imatra (Finland).
R. Hakulinen, and M. Salkinoja-Salonen.
Process Biochemistry, Vol 17, No 2, p 18-22, March/April, 1982. 7 Fig, 5 Tab, 30 Ref.

Descriptors: *Pulp and paper industry, *Anaerobic digestion, *Fluidized beds, *Wastewater treatment, Industrial wastewater, Aerobic digestion, Biological treatment, Mutagens, Toxicity, Daphnia, Trickling filters, Bleaching wastes, Pulp wastes, Chlorophenols.

Three pulp and paper mill wastewaters (spent bleach liquor from kraft pulping, thermomechanical pulping effluent, and debarking wastewater) were treated by fluidized bed anaerobic digestion followed by secondary aerobic treatment. In the pilot plant BOD removals were: bleach liquor, 61-73% at hydraulic loadings of 1.5-3 cu m per cu m of total reactor volume; thermomechanical pulping effluent without dithionite, 94% for a loading of 1 cu m per cu m; 90% for thermomechanical pulping effluent with dithionite for a loading of 1 cu m per cu m; and 82% for debarking wastewater at a loading of 0.66 cu m per cu m. 93-95% of chlorophenolic compounds from bleach liquor at the 1.5 cu m per cu m loading were mineralized to CO2 and chloride ions. All mutagenicity (monitored by the Ames test) and toxicity to Daphnia were removed from the wastewaters. (Cassar-FRC)
W82-06226

HOW APPLETON REDUCED PHOSPHORUS,
Wastewater Treatment Plant, Appleton, WI.
P. Wachs, and E. L. Laurent.
Water/Engineering and Management, Vol 129, No 5, p 32, 34, May, 1982. 2 Tab.

Descriptors: *Phosphorus removal, *Wastewater treatment, Water treatment facilities, Appleton, *Wisconsin, Alum, Biochemical oxygen demand, Oxygen demand, Regulations, Chemical coagulation, Seasonal variations, Flow, Industrial waste.

Chemical processing facilities were installed in the late 1930s in the city of Appleton, Wisconsin, to treat domestic and industrial wastewater. The plant performed seasonal chemical treatment during periods of low river flow. Industries in the area included paper mills, canneries, dairies and small industries. The plant could not meet the modern state phosphorus concentration requirements. In the early days rduction of phosphorus was accomplished by adding metal salts. Recently, the return of the sludge oxidation decant liquor to the head of the aeration tanks interfered with the ability of the added metal salt to react with phosphorus. Liquid alum was applied in 1980 at the end of the aeration process and successfully reduced phosphorus to the required levels. The alum was compatible as a coagulant with the sludge oxidation decant liquor, and this solids reduction method is currently in use. Solids which are recovered are then concentrated and spread over nearby farm land as fertilizers. Activated sludge is moved from secondary clarifiers to four dissolved air flotation units for thickening. Primary clarifier sludge is added to the thickened sludge, and the mixture passes to a wet oxidation stage. Oxidized sludge is transferred to decant taxes. The plant now meets the state phosphorus limit of 1 mg/liter in the effluent. Increased removal efficiencies of BOD and suspended solids have also been achieved. In the returned activated sludge, total suspended solids vary from 9,000 to 11,000 mg/liter. Mixed liquor TSS range from 2,500 to 4,000 mg/liter. Sludge volume index remains between 60 and 70, which indicates very good settling. (Baker-FRC)
W82-06249

POLYMER PLAYS PLANT IMPROVEMENT ROLE,
W. VanCott, and J. F. Moore.
Water/Engineering and Management, Vol 129, No 5, p 48, 50, May, 1982.

Descriptors: *Wastewater treatment, *Phosphate removal, Economic aspects, Activated sludge process, Polymers, *Ohio, Management, Toledo.

Changes have been instituted at the Bay View Water Reclamation Plant in toledo to improve performance and stay within the limits imposed by the Ohio Environmental Protection Agency. These changes include a reduction in operating personnel, control of maintenance overtime, adoption of a preventive maintenance program, institution of chemical and energy reduction programs, implementation of operator training and safety seminars, and negotiation of a new sludge hauling and land spreading contract. A significant change in phosphate removal with resultant savings in chemicals and direct labor was also brought about through the use of a new gel polymer installation at the primary clarification stage. A steel mill waste pickle liquor was used in place of ferric chloride in the preaeration tanks, with resultant chemical cost savings of over 90%. The anionic polymer was needed to settle the iron phosphate precipitate that formed. The polymer is injected into the inlet channels of the primary clarifiers, where it contacts the phosphate floc in the wastewater stream and begins to promote settling. A gel grinding unit was installed as part of the completely automatic mixing system. This significantly reduced the time spent in the chemical building to maintain equipment and keep the area clean. Phosphorus concentration in the treated effluent averaged 0.6 mg/liter during 1980, and the plant kept within standards during 1981. (Baker-FRC)
W82-06250

A LEGACY FROM CONSTRUCTION GRANTS,
Donohue and Associates, Inc., Sheboygan, WI.
J. S. Kipp.
Water/Engineering and Management, Vol 129, No 5, p 38-40, May, 1982.

Descriptors: *Sewer systems, *Maintenance, Federal jurisdiction, Environmental Protection Agency, Grants, Construction.

Communities must begin to face wastewater related problems in innovative ways. Participation in scores of wastewater collection and treatment projects has provided consulting firms with the opportunity to observe a broad range of system conditions and configurations. During sewer system studies the full spectrum of system maintenance situations has been encountered, from emergency-only responses to planned and full scale sewer maintenance programs. The new approaches, along with recently developed repair methods and products, represent long term benefits of the declining Construction Grants Programs. A comprehensive program for collection system maintenance includes a series of support functions, inspection techniques and repair methods. Planned and carried out on a regular basis, such a program identifies, documents and repairs sewer system defects to mitigate the effects of existing deficiencies and prevent the development of new problems. A typical sewer maintenance program can consist of three distinct phases: smoke testing, surface survey of manholes and manhole frame testing; dye water flooding and complete man-hole inspection; and sewer cleaning, internal television inspection and root control. System size, sewer age, existing problems, present maintenance staff and future areas for expansion all need to be addressed when establishing a program. (Baker-FRC)
W82-06251

SEWER MAINTENANCE AND REHAB OPTIONS,
Burns and McDonnell, Kansas City, MO.
P. L. Andrews, and S. A. Yonker.
Water/Engineering and Management, Vol 129, No 5, p 38-40, 42, 46, May, 1982. 2 Tab.

Descriptors: *Sewer systems, *Maintenance, Linings, Pipes, Inspection, *Rehabilitation.

The Environmental Protection Agency has a requirement in its construction Grants proram that excessive amounts of infiltration/inflow entering sewer systems be eliminated. Concern for cost, safety and reliability has spawned new sewer cleaning and rehabilitation techniques, materials and methods. Sewer deterioration can be caused by a number of different circumstances, including corrosion or structural failure. For many years sewer cleaning was the only method other than replacement used to rehabilitate sewers. The variety of methods available for sewer cleaning includes rodding machines, bucket machines, and hydraulic cleaning devices. The effectiveness of sewer cleaning equipment will vary depending upon local conditions. Accessibility to the sewer is also a determining factor. Inspection of the sewer system is needed if other sewer rehabilitation steps are to be taken. Television inspection is the most prominent of the techniques for inspection which are available. The inspection is made to identify the type and location of defects. Rehabilitation methods once the problem is located include various methods and materials, most involving replacement or restoration of the interior surface of the pipe and the integrity of the pipe joints. Procedures external to the pipe are potentially effective as well. External methods involve methods involve the use of various grouts. Replacement or restoration of the interior pipe wall may call for slip lining, which involves inserting a polyethylene pipe with an outside diameter slightly smaller than the inside diameter of the original pipe being repaired. A recent adaptation of slip lining involves use of a resin-saturated fabric tube. (Baker-FRC)
W82-06253

THE QUANTIFICATION OF THE EMISSIONS AND DISPERSION OF ODOURS FROM SEWAGE-TREATMENT WORKS,
Warren Spring Lab., Stevenage (England). Pollution Div.
A. W. C. Keddie.
Water Pollution Control, Vol 81, No 2, p 266-279, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Odor control, Odors, Public opinion, Air pollution. Air circulation, Atmosphere.

In this paper the relative importance of sewage treatment/disposal as a source of odor complaints is briefly reviewed and then some of the problems of identifying and quantifying odorous emissions are described. The role and limitations of atmospheric dispersion in diluting odors to acceptable levels are outlined. According to a recent survey carried out in the United Kingdom, sewerage and sewage treatment still accounts for a significant number of identified sources of odors and for numerous complaints from the general public. There are many potential odor sources within a treatment works, including incoming sewage, primary sedimentation, biological treatment and holding tanks, sludge digestion and sludge disposal. While it is hard to quantify the volume flow of odorous air

and consequently the odor emission rate, these difficulties can be partly overcome by making use of the knowledge of atmospheric dispersion. Chemical analysis of odorous compounds emitted from sewage works, using methods based on gas chromatography, has met with only limited success in respect to identifying source and quantification. Using relatively simple dispersion formulae, corrected for the fact that the human nose responds to stimuli of only a few seconds duration, and given an estimate of the total emission from a works it is possible to calculate the potential for complaints from the public for a works in question. (Baker-FRC)
W82-06255

EXPERIMENTAL DATA ABOUT WASTEWATER TERTIARY TREATMENT WITH OZONE,
Trailigaz Co. (France). Research and Application Dept.
J. P. Legeron.
Water Pollution Control, Vol 81, No 2, p 166-176, 1982. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Ozone, *Tertiary wastewater treatment, Advanced wastewater treatment, Sewage, Coliforms, Bacteria, Disinfection.

Ozone treatment was tested in a pilot plant on semi-industrial effluents, which also included waste from hospitals and clinics. The wastewater in question had previously been given treatment comprising screening, grit and oil removal, primary sedimentation, biilogical treatment by activated sludge and secondary settlement. It was then discharged into a river reaching the sea less than 10 km downstream. The risk of health and hygiene problems had to be reduced by disinfection because oyster farms and bathing areas were located near the mouth of the river. The pilot plant includes an ozone generator and a gas-liquid contact system. With this equipment 36 g of ozone can be produced per hour at a 2% concentration by weight. With a distribution pattern of 40%, 40%, 15% and 15% and a dosage rate of 10 mg ozone per liter of effluent, a total coliform content of no more than 1000/100 ml can be obtained in most cases. A retention period of 11 minutes 20 seconds proved more effective than 20 minutes. While a relation was found between the effective dosage rate and the ozone content in the carrier gas, the reduction in coliforms also depended on water quality. Ozone can also be injected so that only traces of dissolved ozone will be present in the water at the outlet from the first column, with a concentration of 0.3 mg/liter in the effluents from the other three columns, without impairing the degree of disinfection. Such a factor can be used for setting up a process control system linking ozone production to the quality variations of the sewage effluent. (Baker-FRC)
W82-06257

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,
North-West Water Authority (England).
A. P. Michaelson, J. L. Thompson, A. M. Bruce, and R. C. Frost.
Water Pollution Control, Vol 81, No 2, p 220-240, 1982. 14 Fig, 2 Tab, 19 Ref.

Descriptors: *Sludge, *Pumping, *Reviews, Economic aspects, Conveyance, Rheology, *Wastewater treatment, Pipelines, Hydraulics, Design criteria, Viscosity, Mathematical studies, Model studies, Sludge thickening, Pumps.

This paper provides a broad account of the results obtained from two studies, one related particularly to the use of pipelines for transporting sludges over very long distances, and the other on sludge pumping. The rheological behavior of sewage sludges is generally described as 'non-Newtonian' and is more complex and variable than that of Newtonian fluids. In designing a system for pumping sludges it is essential to obtain an accurate estimate of the friction losses likely to occur over the range of designflow rates and likely pipe diameters. Rule of thumb assumptions about the flow behavior of sludges may lead to substantial errors in prediction of head losses under some flow conditions. Even pipelone systems of relatively short length, such as within a system, can present design uncertainties, especially where thickened sludges are to be pumped. For most types of sludge, friction head losses in pieplines when flow is in the turbulent range are normally no greater than 1.5 times those for water flowing at the same velocity. To predict head losses it is necessary to determine the actual flow characteristics of the particular sludge. The resistance to flow of different sludges is variable and influenced by solids content. The design philosophy should be based on an operating velocity which is high enough to ensure transitional flow for the thickest sludge. (Baker-FRC)
W82-06258

THE USE OF OXYGEN IN SEWAGE TREATMENT,
Wessex Water Authority (England).
R. G. Toms, and M. G. Booth.
Water Pollution Control, Vol 81, No 2, p 151-165, 1982. 4 fig, 6 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Oxygenation, *Reviews, Aeration, Activated sludge process, Sludge, *Oxygen, Wastewater treatment facilities, Unox process, Nitrification.

A broad review is offered of the use of oxygen in the treatment of sewage. A high rate oxygen activated sludge treatment process was first developed in the early 1960s, using oxygen in place of air to accomplish biochemical oxidation. Such treatment was begun in 1976 by the Wessex Water Authority due to the small land requirement for the process to be effective. This was the first Unox plant to be built in the United Kingdom, and its efficiency has been studies in detail. Oxygen treatment was also used to uprate an activated plant at Holdenhurst. An examination of the plant showed that the aerators in the activated sludge process were not able to maintain a satisfactory dissolved oxygen content of 4% saturation half-way along the aeration lanes with a minimum of 10% saturation at the outlet. The low DO content caused the plant to produce an effluence below acceptable standards. An additional 5.5 tonnes/day of oxygenation capacity were needed for full nitrification. Additional oxygenation capacity, once installed, resulted in a good quality effluent being produced, with about 91% of the BOD load and 13% of the ammonia load being removed. Oxygen was also used to treat sewage in a rising main. The Saltford sewage treatment works became overloaded and in the early 1970s did not produce an acceptable effluent. Peformance at the plant was seriously affected by a poor-settling activated sludge, associated with the presence of filamentous bacteria in the influent, whose presence was attributed to the fact that the crude sewage was septic. Oxygen was injected into the bottom of the rising main in the pumping station, eliminating the filamentous bacteria, but not improving settleability of the activated sludge. (Baker-FRC)
W82-06262

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,
Turbitrol Co., Atlanta, GA.
E. F. Morey.
In: Water/Engineering and Management, Reference Handbook--1982, p 6-7, May, 1982.

Descriptors: *Maintenance, *Measuring instruments, Operating costs, Planning, Electrical equipment, Hydraulic equipment, Laboratory equipment, Mechanical equipment.

Basic ideas and principles of instrument maintenance in water and wastewater treatment plants are considered. Instrument maintenance may be divided into two main areas - the management aspect and the technical phase. Management involves decisions about how to establish the manpower that will be needed to peform the work and procedures for establishing the acutal maintenance programs. The technical areas involve the aspects of maintaining, adjusting, and repairing instrument maintenance shop available where bench service work can be performed. Good documentation is essential for proper operation of an instrument maintenance department. Some type of record system is needed to permit maintaining a chronological history of the maintenance and repair work done on each instrument device. For pneumatic and electronic instruments it is essential that the system be protected from problems associated with a bad air supply and a 'noisy' power supply. Electronic instrumentation should be provided with filters for the supply to the devices. Well-designed instrumentation and control systems have the potential of providing significant increases in plant operating efficiency. In order for proper maintenance to be done the operating staff will have to have that level of confidence that will result in a better job performed with higher efficiency. (Baker-FRC)
W82-06263

HOW TO SET UP A PREVENTIVE MAINTENANCE PROGRAM,
Operation Management Services, Wilton, CT.
B. W. Dahl.
In: Water/Engineeing and Management, Reference Handbook-1982, p 8-12, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Maintenance, *Planning, *Wastewater facilities, Electric equipment, Hydraulic equipment, Mechanical equipment, Laboratory equipment, Measuring instruments.

A preventive maintenance program in a wastewater treatment plant calls for secheduled cleaning, lubrication and minor adjustment of parts that do not require major overhaul or repair. The basis of such planned maintenance is scheduled inspection of all facilities, including inspection of all electrical switch gear and instruments as well as the mechanical equipment. This leads to discoveries of equipment that could cause breakdowns or harmful deterioration to occur. The first step in developing such a system is to determine the needed information. The second step is to make a preliminary assessment of the size and scope of the plant and the resultant preventive maintenance system so that one can intelligently select the hardware appraoch to be used. General components of the system must be defined, including an equipment identification system, a record of facts on each piece of equipment, a schedule for documentation of service performance, and a format for monitoring inventory of spare parts. Aside from the basic hardware all systems have the same pattern of data flow, consisting of the equipment lists along with all the specific data and schedules on each piece of equipment. This data forms the data base for system operation. The development of a preventive maintenance system calls for the initial survey of the size of the system needed and selection appropriate hardware, the assembly of all specific information on the equipment, and the fine tuning of the system. (Baker-FRC)
W82-06264

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
M. P. Pandey, and M. Chaudhuri.
Water Research, Vol 16, No 7, p 1113-1118, July, 1982. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Mercury, *Water treatment, Sorption, Adsorption, Coal, Oxidation, Activated carbon, Carbon, *Wastewater treatment.

Results are presented from a study conducted to screen a number of Indian bituminous coal samples for mercury sorption in water and improve the sorption capacity of the most promising one through chemical pretreatment. Continuous column studies were also conducted using mercury levels that are commonly encountered in natural water supplies or industrial wastewaters. The kinetics of mercury sorption onto activated carbon and coal samples was investigated. The two activated carbon samples were used as references to compare the performance of the coal samples. For all the sorbents the time required to attain equilibri-

um sorption was about 12 hr. Filtrasorb 400 and Laxmi Carbon were comparable in terms of their initial rates of sorption as well as equilibrium mercury sorption capacities. Inital rates of sorption for Margherita and Makum coals were slightly lower compared to those for Giridih and singareni coals. Mercury sorption onto Giridih coal was temperature dependent and decreased with rising pH as well as chloride and calcium concentrations. Sorption follows the Freundlich equation and involves a rapid interaction between mercury and the active sites on the external surface of coal, followed by intraparticle diffusion of mercury for further rection. Chemical pretreatment of coal such as with nitirc acid oxidation, sulfonation and sulfurization further improved the sorpiton capacity. Column studies indicated the feasibility of using coal for removing mercury from water supplies or industrial wastewater. (Baker-FRC)
W82-06265

OPERATION OF HIGH-RATE OXIDATION PONDS: THEORY AND EXPERIMENTS,
Technion-Israel Inst. of Tech., Haifa (Israel).
Y. Azov, and G. Shelef.
Water Research, Vol 16, No 7, p 1153-1160, July, 1982. 6 Fig, 4 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Oxidation ponds, Oxidation lagoons, Lagoons, Temperature effects, Seasonal variation, Algal growth, Eutrophication, Solar radiation.

This study was aimed at achieving maximum algal biomass production and wastewater reclamation from a high oxidation pond through designing an operational strategy that would require minimal pond area for year round aerobic operation of the pond. It was assumed that increasing the algal portion of the total biomass produced in the pond would result in increased nutritional value of the biomass, subsequently harvested for use as protein rich animal feed. Theoretical considerations and year round outdoor pilot plant experiments were studied to compare the different basic approaches of large scale high-rate oxidation ponds (HROP) operation aimed at optimizing the performance of the system. Major factors affecting pond performance were solar radiation and water temperature: the former mainly determines maximal algal productivity, and the latter determines optimal retention time operation. Pond area and depth are the only true independent variables which may be manipulated to produce optimal retention time in year round operation. In the tropical regions, a constant retention time is most adequate for optimal operation, as water temperature is fairly constant year round and a constant area and depth strategy can be adopted. In moderate climates seasonally variable retention time is preferred, and it was found to be most economically achieved by varying pond depth at constant area. Another plausible strategy with possible economic advantages is a combination of dual function ponds, operating solely for wastewater treatment during winter, while some are converted into fish-rearing ponds during summper. (Baker-FRC)
W82-06266

A REVIEW OF THE MECHANISM OF POWDERED ACTIVATED CARBON ENHANCEMENT OF ACTIVATED SLUDGE TREATMENT,
C-E Natco, Tulsa, OK.
K. L. Sublette, E. H. Snider, and N. D. Sylvester.
Water Research, Vol 16, No 7, p 1075-1082, July, 1982. 1 Fig, 1 Tab, 47 Ref.

Descriptors: *Activated sludge process, *Reviews, *Wastewater treatment, Carbon, Sludge, *Activated carbon, Chemical reactions, Synergistic effects.

This paper reviews the available literature concerning powdered activated carbon enhancement of activated sludge treatment. Much investigative work has been devoted in the past 10 years to understanding the interaction of carbon adsorption and biological activity. Simple addition of effects seems unlikely, and an apparent synergism has been suggested. The source of this synergistic effect has been attributed to stimulation of biological activity through removal of inhibitory substances or concentration of nutrients and to bioregeneration of the adsorptive capacity of activated carbon. The relative importance of these synergistic mechanisms appears to depend largely on the characteristics of the wastewater and the nature of the organisms that make up the biomass. Removal of inhibitory substances and bioregeneration are most important with regard to activated sludge treatment of complex wastewaters. More study is needed to elucidate the complex relationship between the presence of an adsorptive surface and the performance of a biological treatment system. Considerable insight could be gained from using simple nutrient solutions containing single organic carbon sources as feeds. If extracellular enzymes can be detected in a biological reactor by virture of the production of metabolic intermediates in the bulk medium, an investigation of the effects of activated carbon on the degradative activity of medium made cell free could be enlightening. (Baker-FRC)
W82-06268

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
M. S. Gould, and E. J. Genetelli.
Water Research, Vol 16, No 5, p 749-753, May, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Heavy metals, *Digested sludge, *Adsorption, *Fate of pollutants, *Regression analysis, Mathematical models, Cadmium, Nickel, Copper, Zinc, Hydrogen ion concentration, Statistical analysis, Temperature effects, Mathematical studies, Enthalpy, Entropy, Model studies, *New Jersey.

The effect of temperature on the binding of Cu, Zn, Cd, and Ni to anaerobically digested sludge was investigated using sludge from the sewage treatment plant at the Marlboro State Hospital in New Jersey. Two different procedures were used for equilibrating and adjusting the pH of heavy metal salt and sludge mixtures. Solids metal content, soluble metal concentration and pH were determined after each equilibration, and results were analyzed by regression analysis using the Statistical Analysis System. The effect of pH, temperature, and solute concentration on heavy metal partitioning with sludge solids was estimated using the van't Hoff equation combined with the Freundlich isotherm and a pH term. Enthalpies for Zn, Ni, and Cd reflect overall endothermic behavior, while results for Cu show that changes in temperature have very little effect. Entropy effects were more suitable than enthalpy effects in explaining the high stability associated with heavy metal/sludge binding. When the temperature is decreased, Zn, Ni, and Cd are solubilized. (Geiger-FRC)
W82-06270

BIOLOGICAL EQUILIBRIUM IN A WASTEWATER RESERVOIR,
Ben Gurion Univ., Sed. Boker (Israel). Lab. for Applied Environmental Microbiology.
A. Abeliovich.
Water Research, Vol 16, No 7, p 1135-1138, July, 1982. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Wastewater lagoons, Reservoirs, *Anaerobic conditions, Algae growth, Oxidation, Municipal wastes, *Israel, Ram reservoir.

Observations were carried out during 1979-1980 in the Ram reservoir, located 2 km east of Beer-Sheva, Israel. The reservoir is 6 meters deep, its area is 20 acres, and it is able to store up to 500,000 cubic meters of effluent from the local municipal oxidation ponds. At present the deep Ram wastewater reservoir behaves as a biologically stable water body with respect to both algal species and algal concentration, in spite of the great diurnal and seasonal variability in water quality and the fluctuations in the various physicochemical and biological parameters measured such as temperature, concentration of biochemical oxygen demand, and ammonia. This stability suggests the presence of factors that prevent any succession of species and development of blooms of any algae. A crucial factor in maintaining aerobic conditions at the surface seems to be water depth. During the summer, as long as the water was deep enough to build a stable thermocline to trap all sulfides, ammonia, and particulate organic matter, the surface water could be safely pumped for irrigation. During the winter, water depth and organic load did not play such a critical role in the reservoir, which was generally anaerobic throughout the water column except for the upper 50-100 cm during the day and 10-25 cm during the night. (Baker-FRC)
W82-06282

OXIDATION OF AQUEOUS PHENOL SOLUTIONS IN THE PRESENCE OF POLYELECTROLYTES,
Wollongong Univ. (Australia). Dept. of Chemistry.
J. Land, and J. Ellis.
Water Research, Vol 16, No 7, p 1139-1145, July, 1982. 3 Fig, 6 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Phenols, Industrial wastes, Toxicity, Chemical coagulation, *Biological wastewater treatment, Chemical reactions, Oxidation, Separation techniques, Polyelectrolytes, Electrolytes.

A study was made of the oxidation of phenols with Fenton's reagent in the presence of polyelectrolyte, to explore the possibility of binding phenol oxidation products to the polyelectrolyte and thus removing them by sedimentation instead of by exhaustive oxidation. The polyelectrolytes selected for study were polyethyleneimine (PEI) and polypropyleneimine (PPI). The precipitation of early oxidation products with PEI provided an alternative to exhaustive chemical oxidation as a means of detoxifying phenolic effluents. The properties of the PEI/oxidized phenol adduct showed some similarities to those of corresponding precipitates obtained with complex humic materials and colored substances. Any substituted phenol which can be chemically oxidized to a 1,2-dihydroxybenzene can be aerially oxidized to products which form an insoluble adduct with PEI. The efficiency of this reaction and its tolerance to varying PH and overdose of PEI increases with increasing molecular weight of the PEI. Although the procedure does not alone reduce the phenol concentration to the desired 0.1 mg/liter for discharge, it does show potential for use as a chemical pre-treatment step of high strength effluents which would otherwise be very harmful to a biological treatment system. (Baker-FRC)
W82-06283

DESIGN CRITERIA FOR A COAGULATION-FLOCCULATION PLANT FOR SEWAGE,
Ministry of Transport and Public Works, Middleburg (Netherlands).
J. Leentvaar, R. E. Roersma, and T. S. J. Ywema.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 1-6, February, 1981. 7 Fig, 9 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Sludge, *Flocculation, *Coagulation, Sewage, Pilot plants.

The aim of this study is to obtain some design criteria for a coagulation flocculation plant that operates with domestic sewage. Parallel to these pilot plant experiments jar-tests were carried out to determine the optimal detention time in the different units and the optimal mixing intensity. Experiments were carried out with raw unsettled sewage of the village of Bennekom, which is mainly of domestic origin. The batch experiments demonstrated that a short and intensive mixing period of sewage and coagulant was favorable, although air burst within the fluid was disadvantageous. It was evident that the rapid mix period in the reactor should be equal to or longer than the mixing time required for complete mixing of the liquid in the tank. In batch experiments a G value of about 700/

sec for 7 s gave the best results. In pilot plant studies it was nearly impossible to measure exactly the G value of the rapid mix unit. Also in the pilot plants a higher G value was advantageous together with a plug flow system. The design of the flocculator involves selection of reactor configuration, velocity grdients and detention time. Previous experiments and general design foundations indicated that square tanks would be favorable. The pilot plant experiments indicated that the total organic carbon removal increased strongly using a floc blanket in the sedimentation tank. The sludge properties were not influenced strongly by the design variations of flocculator or sedimentation tank. (Baker-FRC)
W82-06298

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,
Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06305

WASTEWATER CHARACTERIZATION AND TREATMENT SYSTEM DEVELOPMENT FOR A BLUE CRAB PROCESSING PLANT,
Maryland Univ., College Park. Water Resources Research Center.
F. W. Wheaton, K. M. Lomax, and G. Geiger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256520, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 65, April 1981. 29 p, 4 Fig, 6 Tab, 14 Ref. OWRT A-044-MD(1), 14-34-0001-0122.

Descriptors: Blue crabs, Waste disposal, Seafood, Filtration, *Food-processing wastes, Industrial wastes, *Wastewater treatment, *Crabs, Effluent.

Blue crab processing plant liquid effluent was divided into washdown, hand sink and retort effluent. Each stream was characterized using standard water quality parameters. The wastewater was then subjected to settling, flocculation with alum and chitin, centrifuging, foam fractionation, microscreening or aerobic or anaerobic biological treatment and the resultant water quality determined. Aerobic biological treatment appeared to be the most promising method for meeting water quality guidelines. A wastewater treatment system, consisting of a 60-mesh screen, aerated biological treatment with about a two day retention time and chlorine disinfection, was installed in a blue crab processing plant. The 60-mesh screen significantly reduced total suspended solids (TSS) concentrations but not the BOD sub 5. Aerated biological treatment had reduced BOD sub 5 significantly but had little effect on TSS, volatile and non-volatile solids. Chlorination adequately reduced bacterial populations to below 70 MPN/100 ml. (Author abstract)
W82-06306

WATER REUSE BY METAL REMOVAL FROM INDUSTRIAL PLATING EFFLUENTS,
Rhode Island Univ., Kingston.
F. J. DeLuise, and S. M. Barnett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256538, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1981, 22 p, 11 Fig, 9 Ref. OWRT A-073-RI (1). 14-34-0001-1142.

Descriptors: *Metal-finishing wastes, *Water reuse, Industrial wastes, Flotation, *Microgas dispersions, Effluents, *Wastewater treatment, Copper, Nickel, Chromium, Lead, Zinc.

Microgas dispersions (MGD) have been used in a flotation process to remove copper, chromium, nickel, lead, and zinc from aqueous solutions. Solutions of each metal individually, and mixtures of all the metals were synthetically prepared and treated for removal. Removal of these metals from an actual industrial plating effluent was also studied. Metal removals of up to 100 per cent were obtained from solutions of metals ranging in concentration from 2 to 20 ppm. In addition, plating wastes containing several metals were successfully treated. The most efficient treatment system employed the use of a cationic surfactant with precipitate floatation.
W82-06307

ADSORPTION OF ARSENITE AND ARSENATE ON AMORPHOUS IRON HYDROXIDE,
Arizona State Univ., Tempe. Dept. of Chemistry.
M. L. Pierce, and C. B. Moore.
Water Research, Vol 16, No 7, p 1247-1253, July, 1982. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Arsenic, *Adsorption, Sediments, *Iron hydroxide, *Arsenates, Mining wastes, Industrial wastes, *Wastewater treatment.

This study was undertaken to establish quantitatively the isotherms of arsenite and arsenate adsorption on amorphous iron hydroxide at concentrations which range over four orders of magnitude and a wide range of pH. The adsorption capacity of amorphous iron hydroxide was extremely high for arsenic. Adsorption continued to take place even at the highest concentrations of arsenic studied. For initial arsenic concentrations up to 667 micromoles/liter (50 ppm) removals on the order of 35% at a pH of 4 were found, which amounted to an adsorption of 50 millimoles/g. At low concentrations the isotherms obeyed equations of the Langmuir type. At higher concentrations the adsorption isotherms were linear, indicating the existence of more than one type of surface site on the amorphous iron hydroxide adsorbent. Removal of arsenite and arsenate by amorphous iron hydroxide throughout the concentration range were determined as a function of pH. By careful seletion of the relative concentration of arsenic and amorphous iron hydroxide and pH, removals on the order of 92% can be achieved. (Baker-FRC)
W82-06311

ANAEROBIC FILTER TREATMENT OF MOLASSES DISTILLERY SLOPS,
Agriculture and Forestry Univ., Vienna (Austria). Dept. of Applied Microbiology.
R. Braun, and S. Huss.
Water Research, Vol 16, No 7, p 1167-1171, July, 1982. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Anaerobic digestion, *Food-processing wastes, *Distillery wastes, Industrial wastes, *Wastewater treatment, Anaerobic conditions, Beet molasses.

Laboratory and pilot scale anaerobic filter digestion of beet molasses distillery slops were examined as a method of treating these high-strength industrial wastewaters. The slops used had an average dry matter content of between 4.8 and 63% (w/v). Methane fermentations were initiated by adding sludge from municipal sewage sludge digesters at a concentration corresponding to 30% (v/v) of the water filled filters and a dosage of diluted molasses slops (slops:water = 1:). Initial retention times were set between 4 and 6 days. As the volatile fatty acid concentration decreased, the volumetric load was gradually increased by reducing the retention time. Anaerobic flter treatment proved feasible without either pretreatment or water dilution of the slops at comparably high volumetric loadings and low residence times. There was no difference in the efficiencies of the laboratory and the pilot scale reactors. After continuous operation for 1 year there was no obvious sign of clogging. After dismantling the filter the bacterial sludge was easily rinsed from the packing material. The major part of the sludge was submerged in the void space of the filter packing. A considerable improvement in the gas productivity could be achieved through the addition of iron sulfate. Volumetric loadings of up to 50 kg organic dry matter/cubic meter/day, corresponding to a hydraulic residence time of about 1 day, were achieved. (Baker-FRC)
W82-06312

MODELLING OF THE ACTIVATED SLUDGE PROCESS FOR MICROPROCESSOR-BASED STATE ESTIMATION AND CONTROL,
Helsinki Univ. of Technology, Espoo (Finland).
A. Holmberg.
Water Research, Vol 16, No 7, p 1233-1246, July, 1982. 13 Fig, 5 Tab, 32 Ref.

Descriptors: *Activated sludge process, *Model studies, Computers, *Microprocessors, *Wastewater treatment, Mathematical studies, Biochemical oxygen demand, Oxygen demand, Sludge, Oxygen uptake, Algorithms, *State estimation.

This study was aimed at developing and implementing a microprocessor based estimation and control system for the activated sludge process. A simple dynamic process model suitable for state estimation and control using microprocessors is presented. An estimation algorithm for estimation of the biochemical oxygen demand loads of the influent and effluent was developed and implemented using micro-processors. The algorithm also estimated the concentration of sludge and active mass in the different stages of the process and also sludge growth, using available on-line measurements and the oxygen utilization rate, for which a separate estimation method was needed. An algorithm was developed for on-line determination of the oxygen utilization rate and the oxygen transfer coefficient, which are prerequisites for state estimation. A comparison was made of control strategies. The study comprised two experimental periods at a research plant corresponding in size to a municipal treatment plant for 1000-1500 inhabitants. Control of the activated sludge process is discussed and concluded to be a hierarchical two-level problem. The upper level control actions are aimed at bringing the process to an optimal state of operation. For this purpose verbally formulated control laws are used. On the lower level the control task is to maintain the process in the optimal state. (Baker-FRC)
W82-06324

EFFECTIVE PROJECT MANAGEMENT,
CH2M/Hill Inc., Corvallis, OR.
J. Van Munster.
In: Water/Engineering and Management, Reference Handbook-1982, p 17-18, 20-22, May, 1982. 3 Fig.

Descriptors: *Management, *Planning, Construction, Management planning, Project planning, Personnel management.

Construction management is a system than can be implemented as a professional instrument on water and wastewater projects to complete them successfully in spite of the increasingly complex constraits of the marketplace. The principal phases of construction management program are project setup, which establishes the management tools and guidelines for the project; project delivery analysis and management plan, which defines the management tools and technique for selected delivery approach; and implemeting the contruction management approach, which describes the application of the construction management program during design and construction. The advantages that such a management process offers include a comprehensive management program, which provides continuity from project conception through completion; implementation of a management system specifically tailored to the particular requirements of the project; a flexible management approach that permits the owner to select only those services needed to augment his capabilities; a single source of responsibility for all phases of the work; the management expertise and needed tools to manage problems associated with communication, responsibility definition or coordination throughout the life of the project; and a potential savings from reduced overhead cost of all team members who have less management responsibility. (Baker-FRC)
W82-06328

EXTRACTION OF PHENOLIC COMPOUNDS AND ORGANIC ACIDS BY LIQUID MEMBRANES,

Exxon Research and Engineering Co., Linden, NJ. Corporated Research Technology Feasibility Center.
R. E. Terry, N. N. Li, and W. S. Ho.
Journal of Membrane Science, Vol 10, No 2/3, p 305-323, 1982. 11 Fig, 5 Tab, 12 Ref.

Descriptors: *Separation techniques, *Perselective membranes, *Membrane processes, Phenols, *Organic acids, *Wastewater treatment, Membranes, Industrial wates. Semipermeable membranes, Permeability, Model Studies, Mass Transfer.

The application of liquid membrane technology in removing phenolic and organic acid contaminants from wastewater streams is described. As the phenolic compounds and organic acids permeate throught the liquid membranes into emulsion droplets, they react with caustic, the main reactive agent, and become ionized. The ionized species which cannot permeate the liquid membranes are held in the emulsion droplets. A mass transfer model is presented which describes the extraction process. More than 99% of phenol and cresol can be extracted in see than 1 minute, while acetic and propionic acids can be extracted at a much slower rate. The phenolic compounds are extracted at a pH of 7, while the acids can only be extracted low pH. The extraction rates for acetic acid and phenol are the same in individual-compound and binary-mixture permeations. (Geiger-FRC)
W82-06331

REMOVAL OF ZEOLITE TYPE A DURING PRIMARY SEDIMENTATION AND ITS EFFECT ON METAL REMOVAL,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. C. Rossin, R. Perry, and J. N. Lester.
Water Research, Vol 16, No 7, p 1223-1232, July, 1982. 2 Fig, 6 Tab, 26 Ref.

Descriptors: *Zeolites, *Wastewater treatment, Zeolite process, Sedimentation, Lead, Copper, Zinc, Chromium, *Heavy metals, Suspended solids.

The removal of zeolite type A in a pilot scale primary sedimentation system operating in the field, and its effect on metal removal, are reported. With one zeolite free pilot plant acting as a control to the other it was also possible to determine the effect of zeolite on suspended solids and heavy metal removal over a range of hydraulic loadings. At both influent concentrations of zeolite studied (30 and 60 mg/liter) zeolite removal was substantial under all conditions. No evidence of enhanced removal of suspended solids in the presence of zeolite was noted. Removals of lead, zinc, copper and chromium were slightly enhanced in some experiments. The observed improvements in metal removal appeared to be strongly influenced by the sewage matrix. (Baker-FRC)
W82-06338

OPERATING COLLECTION SYSTEMS UNDER FISCAL STRESS,
Charlotte-Mecklenburg Utility Dept., NC.
C. L. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 23-25, May, 1982.

Descriptors: *Financial aspects, *Management, Personnel management, Management planning, Planning, Mechanical equipment.

Municipal managers have been forced into a painful reassessment of existing operations due to the current conditions of fiscal retrenchment at the national level, coupled with the fact that local revenue sources have reached practical political limits. In Charlotte, North Carolina, three critical objectives were sought: to minimize redundancy and maximize efficiency of existing cleanup programs through development of a problem-history-based preventive maintenance effort; to re-examine existing methods of personnel and equipment usage with the aim of detecting and eliminating nonutilized time and correspondingly increasing productivity and efficiency; and to develop comprehensive management information systems that would facilitate implementation and monitoring of the other two objectives. While this effort did not reach all available alternatives in dealing with budgetary retrenchment, there was no question that the effort would continue to pressure for further reductions in the cost of services. (Baker-FRC)
W82-06340

ROTATING BIOLOGICAL CONTACTOR SCALE-UP AND DESIGN,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and D. F. Kincannon.
In: Water/Engineering and Management, Reference Handbook-1982, p 48, 50-54, May, 1982. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, *Rotating biological contactor, Kinetics, Biochemical oxygen demand, Oxygen demand.

Experience gained over the past ten years in the scale-up and design of rotating biological contactor systems is reviewed. Performance data, operating information and kinetic data can be obtained from bench and pilot scale RBC systems for designing full scale systems. One major consideration in using RBC systems is whether the removal efficiency is dependent on the substrate concentration of the wastewater or the hydraulic flow rate. In fact, both flow rate and organic concentration exhibit definite relationships with substrate removal rate and efficiency. Another design approach considers the amount of soluble substrate removed per unit of surface area for each stage of a multistage RBC system. Any design method based on zero, first or second order rate kinetics will be limited to loading conditions within a specific loading range for design of RBCs. The total organic loading design method can accurately predict the amount of biochemical oxygen demand removed per applied BOD loading regardless of apparent zero, first or second order kinetics. The excellent fit of the Monod-type relationship to BOD removed vs. BOD applied allows prediction of BOD removal for any applied loadings desired by application of monomolecular kinetic analysis. The primary mechanism of oxygen transfer in RBC systems appears to be transfer from the gas phase into the liquid flowing over the media during rotation. To effectively accomplish scale-up of RBCs from pilot data, the oxygen transfer capabilities and limitations of the full scale systems must be defined. (Baker-FRC)
W82-06344

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,
Los Angeles County Sanitation Districts, Whittier, CA.
W. E. Garrison, C. A. Nagel, and R. S. Easley.
In: Water/Engineering and Management, Reference Handbook-1982, p 68-72, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Sludge digestion, *Design criteria, Anaerobic conditions, Anaerobic digestion, Digestion, Biological treatment, Biodegradation, Sludge, Wastewater treatment, Sludge disposal, Digested sludge, Fuel.

Various design and operting principles used over recent years in the Sanitation Districts of Los Angeles County have demonstrated that anaerobic digestion can be a very reliable and safe unit operation in a modern sewage treatment plant. The benefits derived in energy return and lack of plant nuisance make the effort rewarding. Rapid acceleration of energy costs in future years will make the anaerobic digestion of sludge solids a vital part of many modern sewage treatment systems. The basic advantages of such a plan include energy recovery, reduced odor potential in subsequent handling, reduced health risk for composting and recycle, and sludge storage and equalization for subsequent dewatering stages. The California plant described treats 15 cubic meters/ sec of sewage in an advanced primary system and currently produces 160,000 cubic meters per day of digester gas, of which 50% is used in the plant and the balance sold to an adjacent oil refinery. Digester gas is used by reciprocating engines to drive large pumps and genertors and as a fuel source in boilers to produce steam for digester heating. Specifics are discussed for the master plan for circular digesters, digester sizing, the mixing system, the heating system, the cleanout system, and safety features. (Baker-FRC)
W82-06347

ROTATING BIOLOGICAL CONTACTOR SYSTEM DESIGN,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and E. D. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 578-588, June, 1982. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Design criteria, *Wastewater treatment, *Rotating biological contactor, Biochemical oxygen demand, Oxygen demand, Wastewater treatment facilities.

The practical application of Wu's model for the prediction of soluble biochemical oxygen demand removal in rotating biological contactor systems is discussed extensively for various operating conditions. In the predictive model wastewater with or without pretreatment is fed on a once-through basis to RBC systems for biological oxidation of waste matter. Recycling of RBC effluent back to the early stages of the system has not been practiced, as no significant increase in treatment efficiency could be related to this practice. Apparently the major factors which directly influence the efficiency of RBC wastewater treatment systems are: influent wastewater characteristics, flow rate and surface hydraulic loading, disc rotation speed, submerged disc depth, liquid retention time, and wastewater temperature. By using the proposed mathematical model, design of mechanical-drive RBC plants for carbonaceous removal can be easily and precisely performed. Calculating the required surface hydraulic loading rate, variables such as influent soluble BOD concentration, wastewater temperature, and others can be thoroughly investigated and determined. The total disc surface area required is equal to the design wastewater flow divided by the calculated surface hydraulic loading. The precision for the percentage of biochemical oxygen demand removal resulting from the use of this model was about 4.64% for the data sets tested. (Baker-FRC)
W82-06355

NITRIFICATION KINETICS AND ITS RBC APPLICATION,
Norton AFB, CA.
C. -S. Huang.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 473-487, June, 1982. 9 Fig, 39 Ref.

Descriptors: *Nitrification, Kinetics, *Wastewater treatment, Ammonia, Nitrogen, Nitrogen removal, *Rotating biological contactor, Filtration.

A stationary, inclined plate on which a nitrifying biological film was developed was used to investigate the nitrification surface reaction model, and a second study on the bench scale was performed with a rotating biological contactor to see whether the findings of the first study were also applicable to the rotating biological film process. Based on the results of these two studies, it was concluded that the nitrification process follows a zero-order reaction both in stationary fixed-film systems and in rotating fixed-film systems. The pseudohomogeneous surface reaction model can be applied to both trickling filter systems and RBC systems. That is, the nitrification efficiency in a trickling filter process depends on the characteristics of the packing media used and the reciprocal of the two-thirds power of the hydraulic loading. Thus, in a RBC nitrification system, ammonia-nitrogen removal is a function of the square root of the rotation speed up to a certain speed. The active microbial film in a nitrifying RBC unit may be

estimated by locating the optimum ammonia-nitrogen removal rotation speed and the corresponding liquid film thickness at that rotation speed. The RBC unit used in this study has an active (or effective) slime thickness of about 72 micrometers. (Baker-FRC)
W82-06356

DESIGN APPROACH TO DUAL-POWER AERATED LAGOONS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 532-548, June, 1982. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Design criteria, *Aerated lagoons, Lagoons, Oxidation, *Wastewater treatment, Biochemical oxygen demand, Oxygen demand, Kinetics.

Completely and partially suspended lagoon cells are defined and their use in dual-power level, multicellular systems is discussed. A procedure is presented for designing a dual-power level, multicellular aerated lagoon system on a rational basis using biokinetic coefficient data. The aeration cells can be designed as inverted, truncated pyramids. Center depth should be no less than 3 meters, and for many earth materials in which a cell is constructed, a slope no steeper than 1:3 (vertical:horizontal) should be used. Influent pipes to all the aeration cells should discharge at a shallow depth below the aerators. Effluent from the first cell should be withdrawn from behind a surface baffle. Effluents from all the other aeration cells should be withdrawn at the surface without surface baffling so as to avoid retention of any algae that might be generated in the system Riprap or a concrete apron should be placed at the water line to prevent erosion. The size combination selected for the design should reflect the following considerations: capital cost, operating cost, algal growth potential, and depth of sludge accumulation in the partially-suspended cells. (Baker-FRC)
W82-06358

PERFORMANCE OF MODIFIED CHLORINE CONTACT CHAMBER,
Worcester Polytechnic Inst., MA. Dept. of Civil Engineering.
F. L. Hunt, and Z. Vogiatzis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 549-561, June, 1982. 6 Fig, 8 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Disinfection, *Chlorine, *Chlorination, Economic aspects, Baffles, Design criteria.

A field study was conducted to determine the effectiveness of perforated baffles was to increase the hydraulic efficiency and lower the required dosage of chlorine. Field evaluations were conducted at the Maynard, Massachusetts, Municipal Wastewater Treatment Plant Chlorine Contact Chamber. This study did not distinguish between applied chlorine dose and actual chlorine dose. The chlorine demand is considered to be negligible. In addition no distinction was made between a free chlorine residual disinfection response and a combined chlorine residual disinfection response. The findings suggest that tracer responses from the model unit and the field unit were similar. Future model scale studies to further quantify disinfection process responses while varying disinfectant types or modes of application of the model unit can be attempted. Field tracer responses in the unmodified and modified field units correspond closely with the curve generated through a specific equation. Use of the batch reactor data and tracer data is therefore acceptable for the chlorine contact chamber unit evaluated in this study. Tracer data comparing the unmodified and modified CCC units show an improvement in the modified unit. Installations of these baffles in this CCC unit parallel the performance of a CCC unit that has a length-of-flow to width ratio of 25/1. Disinfection efficiency was improved 24% in the modified unit. About a 10% lower chlorine dose was needed. A cost evaluation indicates that these baffles should be cose effective, with the percentage saved depending on the average applied dose. In addition to cost savings, the benefit of lowering chlorine usage and lessening the release of chlorinated organics in wastewater effluents will reduce potential pollution dangers. (Baker-FRC)
W82-06359

EVALUATION OF THE 'LECTRO CLEAR Z' ELECTRO-COAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREATMENT.
Western Industrial Labs. Ltd., Edmonton (Alberta).
Environment Canada, Ottawa, Environmental Protection Service, Report No EPS 4-WP-82-1, January, 1982. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Water quality control, *Meat processing industry, Electrical equipment, *Coagulation, Suspended solids, Biological oxygen demand, Industrial waste, Sanitary engineering, Design criteria, Process control, Engineering, Civil engineering, Cost analysis, Industrial plants, Food processing industry, Catchment basins, Discharge capacity, Economic evaluation, Wastewater facilities, Sewer systems, *Electro-coagulation.

Serious sewage treatment problems were encountered in Lethbridge, Alberta, due to its large number of food processing plants. An eight-week detailed evaluation was conducted in 1980 to assess the operation of a Lectro Clear Z (LCA) unit installed at a Lethbridge meat packing sewage system. As a result of this evaluation, it was determined that the LCZ unit could achieve BOD and suspended solids reduction of about 55-65% on the total existing catch basin effluent. In addition to achieving an acceptable level of treatment, it was confirmed that by-product recovery from the LCZ skimmings was possible. While the subject plant had an existing pretreatment basin, new plants or plants without existing basins must consider some kind of sedimentation and equilization for preparing wastewater prior to the LCZ unit. Further, unexpected occurrence and persistence of electrical problems for the LCZ unit suggests that tighter manfacturing specifications, installation, and operation of the electrical components should be considered. Specific recommendations are given for various topics concerning LCZ operation, including wastewater conductivity, pH adjustment, LCZ influent temperature, hydrogen sulfide formation, and turbulence in the coagulation section of the unit. An economic evaluation of the system was also made. (Zielinski-MAXIMA)
W82-06378

EVALUATION OF BIOLOGICAL NITRIFICATION - DENITRIFICATION AT PENTICTON, BRITISH COLUMBIA,
International Environmental Consultants Ltd., Islington (Ontario).
K. L. Murphy, and R. W. Wilson.
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-10, 1981. 72 p, 13 Fig, 13 Tab, 33 Ref, 2 Append.

Descriptors: *Biological wastewater treatment, *Municipal wastewater, Design criteria, *Denitrification, *Sanitary engineering *Cost analysis, Biological treatment, *Wastewater treatment, Wastewater, Process control, Nitrogen removal, *Nitrification, Organic carbon, Engineering, Civil engineering, Water quality control, Water quality, Activated sludge.

A study was undertaken to review proven methods for removing biological nitrogen (N) from municipal wastewater, to select suitable design parametrers, and to prepare process designs and capital/operating cost estimates for process alternatives appropriate for Penticton, British Columbia. Detailed process option evaluations were made for: two-sludge nitrification plus denitrification; one-sludge post-denitrification; and one-sludge pre-denitrification. Process designs were based on achieving up to 5 mg/liter nitrate-N and 1 mg/liter TKN in the treated effluent throughout the year. The pre-denitrification process was found to be the most cost effective, the design being based on a 20-day solids residence time (SRT) for the nitrification basin and a 10-day SRT for the denitrification basin to ensure efficient N removal at a minimum operating temperature of 8 degrees. The cost of combined carbon and N removal be pre-denitrification was estimated to be about 25% higher than for carbon removal by activated sludge, and 10% higher than for carbon removal and nitrification alone. Land disposal, ammonia stripping, and ion exchange were estimated as more costly than biological N removal methods. General costs are given for N removal at wastewater treatment facilities handling 5000-45000 cu m/day. (Zielinski-MAXIMA)
W82-06379

PILOT SCALE ASSESSMENT OF THE BIOLOGICAL FLUIDIZED BED PROCESS FOR MUNICIPAL WASTEWATER TREATMENT.
Dearborn Environmental Consulting Services, Mississauga (Ontario).
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-11, 1981. 148 p, 73 Fig, 43 Tab, 69 Ref.

Descriptors: *Biological wastewater treatment, Pilot plants, *Fluidized bed process, *Municipal wastewater, *Wastewater, *Oxidation, *Wastewater treatment, Nitrification, Biological oxygen demand, Activated sludge process, Suspended solids, Municipal wastes, Sewer systems, Wastewater facilities, Fluidized beds, Ammonia, Process control.

Pilot-scale studies of the oxygenic biological fludized bed process demonstrated that the system is a technically-feasible alternative to carbon oxidation and nitrification of municipal wastewaters. The design organic loading of the bed is limited by the ability of the process to remove suspended particulates. A treated effluent containing below 15 mg/liter filterable BOD-5 was consistently produced at a loading rate of 10 kg BOD-5 cu m/day (an order-of-magnitude higher than for conventional suspended growth systems (CSGS). Operation at a volumetric loading similar to CSGS was necessary to attain below 15 mg/liter total BOD-5 without effluent polishing, due to the contribution of suspended solids in the final effluent BOD-5. The bed responded rapidly to influent condition changes and was less susceptible to influent disturbances than the activated sludge and rotating biological contactor processes in terms of effluent filterable organic carbon concentration. Significant deterioration occurred in effluent quality in terms of suspended solids levels under diurnally-varying flow/concentration conditions. Separate stage nitrification studies did not show the order-of magnitude increases in volumetric ammonia oxidation rates claimed by other workers. Despite apparent limitation concerning suspended solids removal during separate stage nitrification of high quality secondary effluent, the process demonstrated a potential for use in several wastewater treatment areas. (Zielinski-MAXIMA)
W82-06380

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,
Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-7E, February, 1982. 130 p, 7 Fig, 5 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

Joint treatment of industrial and municipal wastewaters requires a system for computing equitable charges to treatment facility users. A computer program (TAREP) has been developed for this purpose. Information is presented for using the TAREP program to establish a distribution of costs for wastewater treatment. Also included are instructions for coding data, a description of the TAREP subroutines, the program (in FORTRAN) taken from a run on the University of Montreal's CYBER 173, and the results of that run. TAREP is applicable in municipalities where there is joint industrial /municipal wastewater treatment, and can be used to establish charges to ratepayers where treatment facilities are already in place, as well as for preliminary studies leading to the construction of such facilities (thereby enabling municipalities and users to judge whether joint treatment is economically sound). The principles underlying TAREP and case histories conducted using this program are described in the first volume of this 2-volume set. (Zielinski-MAXIMA)
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,
Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-6E, February, 1982. 209 p, 17 Fig, 1 Tab, 39 Ref, 14 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

Joint treatment of industrial and municipal wastewater raises the problem of establishing equitable charges to treatment facility users, since industrial wastewaters carry higher contaminant loads than domestic wastes. The technical background, development, and testing of a computer program for the allocation of user costs for wastewater treatment systems are described. The second volume of this 2-volume set represents the user's manual for this program (TAREP). User charges provided by the program are based on wastewater volume and pollutant loading. Twelve cost factors are provided for use in the program (4 each relating to current users, future industrial use, and property), which can be used/discarded depending on the case under consideration. Case studies were conducted for the program in Waterloo and Granby, Quebec. Data used in these studies included: wastewater flows from various sources (domestic, industrial, groundwater infiltration, public uses, stormwater runoff); average pollutant loadings in such flows; design capacities of the treatment plants and sewers; costs associated with construction/operation/maintenance of facilities; property assessments and areas; saver type serving each property. A program was also developed to evaluate the sensitivity of the charges generated by TAREP to cost breakdown changes. Estimated implementation costs for TAREP are $4500 plus $0.11/inhabitant. (Zielinski-MAXIMA)
W82-06382

APPLICATION OF ULTRAVIOLET DISINFECTION IN A TERTIARY WASTEWATER TREATMENT PLANT,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
K. W. A. Ho.
Research Report No 87, January, 1982. 53 p, 10 Fig, 10 Tab, 31 Ref, 2 Append.

Descriptors: *Ultrviolet radiation, *Tertiary wastewater treatment, *Municipal wastewater, *Sewage bacteria, *Economic evaluation, *Mathematical models, Disinfection, Wastewater treatment, Chemical oxygen demand, Prediction, Municipal wastes, Wastewater disposal, Nitrification, Chlorination, Economic aspects, Economic feasibility, Water treatment, Coliforms.

Applicability of ultraviolet (UV) disinfection technology was investigated for a well-nitrified sand-filtered municipal sewage effluent. Disinfection by UV irradiation is an effective and cost-competitive alternative to a chlorination plus dechlorination (CPD) process. The UV disinfection unit employed consistently reduced effluent total and fecal coliforms to 2500 and 200 per 100 ml, respectively, when operated according to maufacturer's recommendations. In addition, the effluent chemical oxygen demand concentration was found to be a useful surrogate parameter for predicting UV disinfection efficiency, as affected by effluent quality changes. Costs (amortized capital plus operating) for UV disinfection in the sewage effluent was estimated at $0.0433-0.0467/cu m, a cost about 1.2-1.3 times that for a CPD process. This cost, however, is only 49% and 55% that of ozone and chlorine dioxide disinfection costs, respectively. The UV unit quartz sheaths were hand-brushed every 24 hours of continuous operation to free them from fouling by deposits, indicating the need for an automatic sheath wiping system for future UV disinfection units. Development of a semi-mechanistic model for UV disinfection data analysis and its application are reported. (Zielinski-MAXIMA)
W82-06390

A SURVEY OF AERATED LAGOON PERFORMANCE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
W. Lewandowski, and B. Bradley.
Research Publication No 85, October 1981. 58 p, 28 Tab, 3 Ref.

Descriptors: *Aerated lagoons, *Organic loading, *Wastewater treatment, *Stabilization ponds, Surveys, Lagoons, Biological oxygen demand, Aeration, Oxidation, Aerators, Evaluation, Organic Matters, Organic wastes, Suspended solids, Stabilization lagoons, Pretreatment of Water, Wastewater facilities, Water quality control.

Construction of an aerated cell (AC) ahead of a waste stabilization pond (lagoon) system can be used to reduce the organic load to the existing system. Five wastewater treatment systems were surveyed to determine if completely mixed ACs or facultative ACs represent viable means of pretreatment for reducing organic loads to existing stabilization ponds. It was determined that substantial reductions in BOD-5 and suspended solids are achieved by the pretreatment ACs; however, the pretreatment cells do not prevent anaerobic conditions in the stabilization ponds that follow during ice and snow cover periods. Hence, conversion of the ponds to aerated facultative ponds (through sub-surface aeration or post-treatment for hydrogen sulfide removal) may be necessary. Further, with respect to ammonia-nitrogen, the pretreatment cells will not achieve appreciable reductions unless they are modified to achieve complete nitrification throughout the year. The aeration equipment performed satisfactorily at loads close to the design organic load of 463 kg BOD-5/day (1020 lbs BOD-5/day). At comparable organic loads, treatment efficiency with respect to BOD-5 removal is quite similar for both pretreatment processes, but facultative ACs usually produce effluents with considerably lower effluent suspended solids concentrations. (Zielinski-MAXIMA)
W82-06391

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,
Canviro Consultants Limited, Kitchener (Ontario).
E. E. Shannon, H. D. Monteith, and A. K. W. Ho.
Research Report No 82, February 1982. Ontario Ministry of Environment, Toronto. 102 p, 3 Fig, 20 Tab, 70 Ref, 2 Append.

Descriptors: *Organic compounds, *Biological wastewater treatment, *Monitoring, *Chemical industry, *Industrial waste water, Wastewater treatment, Raw sewage, Industrial plants, Industrial wastes, Chemical analysis, Gas chromatography, Mass spectrometry, Quantitative analysis, Fate of pollutants, Path of pollutants, Trace levels, Activated sludge process, Anaerobic digestion.

Research was carried out in two study phases, representing the first Ontario effort to monitor the fate of trace organic contaminants in their passage through a conventional activated sludge plant. In the first phase a field sampling program was conducted in a full-scale plant receiving about 26% by volume of its raw sewage from a single organics manufacturing plant. Analysis of sample extracts by gas chromatography/mass spectrometry detected benzothiazole, diethyl phthalate, dioctyl phthalate, diphenylamine, 2-methyl-mercapto benzothiazole, and aniline as the major organics in all influent, effluent, and sludge samples. In the second phase, an attempt was made to determine the fate of these six contaminants passing through two pilot-scale activated sludge reactors and a pilot-scale anaerobic digester, While mass balances for the six compounds around the three reactors were unattainable due to poor quantitative measurement accuracy, results strongly indicated that aniline removal occurred during activated sludge treatment and dioctyl phthalate accumulated in the activated sludge solids. A more extensive effort towards extraction and analytical methods development is recommended to improve quantitative results before carrying out any further organics monitoring program.(Zielinski-MAXIMA)
W82-06392

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W82-06405

DETERMINATION OF REACTION RATE CONSTANT AND TEMPERATURE COEFFICIENT CONSTANT FOR DADAR SEWAGE, BOMBAY,
Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 107-110, June, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Fate of pollutants, *Mathematical equations, *Temperature effects, *Wastewater treatment, *Microbial degradation, *Graphical methods, Biochemical oxygen demand, Organic wastes, Inorganic compounds, Industrial wastes, Domestic wastes, Biodegradation, Bombay, India.

When industrial and domestic wastes are discharged into water bodies, they are slowly degraded and stabilized by microorganisms, leading to self-purification of water bodies to some extent. The reaction rate of stabilizing such organic and inorganic wastes in what is known as a bochemical oxygen demand (BOD) reaction is temperature dependent. The validity of this first order reaction rate constant under the conditions of the Dadar sewage treatment plant of Bombay, India was determined at different sets of temperatures. The temperature coefficients for Dadar sewage were found to be 1.044, 1.049, and 1.039 for dilution factors of 1:40, 1:50, and 1: 62.5, respectively. Little variation was noted in the reaction rate constant at different sets of temperatures under Indian conditions. The average reaction rate constants were calculated to be 0.19, 0.32, and 0.38 for 20, 27, and 37 degrees, respectively. (Geiger-FRC)
W82-06438

ON-SITE WASTEWATER MANAGEMENT--RECENT TRENDS,
T. Viraraghavan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 60-61, February, 1981. 8 Ref.

Descriptors: *Wastewater management, *Developing countries, India, Rural areas, Septic tanks, *Wastewater disposal, Sanitary engineering.

The 'Management District' concept may help implement a long-term program of on-site wastewater disposal in rural areas of developing

countries. A management district is a publicly owned and operated utility which assumes responsibility for on-site sewers in a designated area. This involves site surveys, septic tank and disposal field design installation of new systems, replacement of faulty systems, monitoring, inspection, and maintenance. The author proposes that India be divided into four such districts for a three-phase study of the system. The phases would consist of: (1) analysis of experiences in the U. S. and Canada and determination of feasibility, (2) site-specific analyses, and (3) implementation. (Cassar-FRC)
W82-06439

GENERATION AND UTILIZATION OF OZONE IN WASTE WATER TREATMENT,
Roorkee Univ., (India).
A. K. Mittal, I. Mehrotra, and R. P. Mathur.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 82-84, February, 1981. 4 Fig, 10 Ref.

Descriptors: *Ozonation, *Ozone, Advanced wastewater treatment, Disinfection, *Wastewater treatment, Tertiary wastewater treatment, Water treatment, Organic compounds, Industrial wastewater treatment, Oxidation.

An ozone generator based on the electric discharge principle was developed and tested for use in treating wastewater effluents, industrial wastes, and water supplies. The equipment, with a 2400 sq cm average electrode surface area and discharge gap of 2.5 mm, was performance tested to produce a set of curves correlating oxygen feed rate with power requirements for desired ozone concentrations and flow rates. The most economical ozone production was 30 mg per liter ozone at a rate of 5 g per hour at an oxygen feed of 190 liters per hour and power requirements of 109 W. Beyond this point slight increases in concentration required sharp increases in power requirements. A graph of ozone production vs. flow rate at voltages from 100 to 150 V was also prepared. (Cassar-FRC)
W82-06442

MEMBRANE SEPARATION PROCESSES,
Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
H. Strathmann.
Journal of Membrane Science, Vol 9, No 1/2, p 121-189, 1981. 29 Fig, 6 Tab, 121 Ref.

Descriptors: *Membrane processes, *Filtration, *Separation techniques, Reviews, Microfiltration, Ultrafiltration, Reverse osmosis, Electrodialysis, Dialysis, Wastewater treatment, Water treatment, Industrial water, Industrial wastewater treatment, Food-processing wastes, Potable water, Chemical wastewater, Metal-finishing wastes, Pulp and paper industry, Desalination, Advanced wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment, Demineralization.

A comprehensive review of membrane separation processes includes fundamentals, chemical engineering aspects, practical experiences, and future perspectives. The principles and applications of separation processes (microfiltration, ultrafiltration, diafiltration, reserve osmosis, electrodialysis, and gas separations) are given. Commercial membranes, their structure, properties, and uses, are discussed in detail. Membrane processes are used in production of potable and industrial water. Microfiltration produces ultrapure water for the electronics industry and removes undesirable substances from process water for chemical, food, and drug industries. Ultrafiltration produces ultrapure water for the electronics industry and sterile, pyrogen-free water for the chemical and drug industries. Reverse osmosis desalinizes sea and brackish water, removes hardness from boiler feed water, deionizes water for electronics and electroplating industries, and sterilizes and deionizes water for the chemical and drug industries. Electrodialysis desalinizes brackish water and softens industrial process water. These processes are also useful in treating industrial and municipal wastewaters. Microfiltration is used for filtration of colloidal and turbid solutions. Ultrafiltration separates oil/water mixtures, recovers electrophoretic paints from rinse water, recovers proteins from food-processing wastewaters, recovers polyvinyl chloride from textile wastewaters, recovers lanolin from wool rinse water, and treats pulp and paper effluents. Reverse osmosis recovers sustances from food-processing industries, treats effluents from the pulp and paper industry, provides secondary or tertiary municipal wastewater effluent treatment, and desalts industrial effluents. Electrodialysis removes heavy metal ions from metal plating rinse water and removes salts from food-processing and industrial effluents. (Cassar-FRC)
W82-06445

AMMONIA NITROGEN REMOVAL IN FACULTATIVE WASTEWATER STABILIZATION PONDS,
Culp/Wesner/Culp, Denver, CO.
A. Pano, and E. J. Middlebrooks.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 344-351, April, 1982. 3 Fig, 10 Tab, 10 Ref.

Descriptors: *Ammonia, *Nitrogen, *Stabilization ponds, Nitrification, *Wastewater treatment, Mathematical equations, *Biological wastewater treatment.

Although ammonia removal from wastewaters is currently associated almost entirely with advanced wastewater treatment processes, ammonia nitrogen removal may be accomplished in facultative wastewater stabilization ponds. Methods by which such removal may take place include gaseous ammonia stripping to the atmosphere ammonia assimilation in algal biomass, and biological nitrification. Low concentrations of nitrates and nitites in pond effluents indicate that nitrification does not normally account for any significant proportion of the ammonia nitrogen removal. Analysis of data from three wastewater stabilization pond systems located in different areas of the United States showed that annual ammonia nitrogen removals above 90% were obtained. There was a statistically significant relationship between ammonia nitrogen removal in the primary ponds and the pH value, water temperature, and hydraulic loading rate. An equation for the ammonia nitrogen removal in facultative stabilization ponds is developed which incorporates water temperature, pH value, and hydraulic loading rate as variables. Application of this model to the ponds showed that ammonia nitrogen removal increases as the pH value, detention time, and temperature increase. At 20 C with a pH value of 8.0 in the primary pond (8.4 in the other ponds), and at a 100-day detention time, the predicted ammonia removal is about 98%. Model coefficients decrease with temperatures above 20 C, probably as a result of thermal stratifiction in the pond system and poor mixing conditions. Verification of the model showed excellent agreement between model predictions of ammonia nitrogen removals and data collected from the test systems and from facultative wastewater stabilization ponds with configurations and climatic conditions similar to those used for model development. (Carroll-FRC)
W82-06454

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,
British Columbia Univ., Vancouver.
D. S. Mavinic, and D. A. Koers.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 352-360, April, 1982. 10 Fig, 20 Ref.

Descriptors: *Nitrogen, *Aerobic digestion, *Sludge digestion, Nitrification, Denitrification, *Wastewater treatment, Temperature effects, Activated sludge, Sludge disposal, Sludge excess, *Fate of pollutants.

Little literature is available pertaining to design and operating criteria for aerobic digestion systems handling waste activated sludges. This study investigated nitrogen mineralization, nitrification, and denitrification processes occurring in several modes of digestion at temperatures of 20 C, 10 C, and 5 C. The modes of digestor operation studied included batch feeding and aeration; once-daily feed with once-daily, manual decanting; and continuous feed with continuous, automatic decanting. Organic nitrogen measurements of aerobic digestor mixed liquor were found to be practically constant, per unit of cell mass, for all systems and sludge ages. This constant organic nitrogen content of the cell mass, together with the absence of organic nitrogen in the supernatants, suggests that volatile solids destruction in aerobic digestion results in almost 100% mineralization of organic nitrogen to ammonia in solution. As a result, a considerable amount of soluble nitrogen may be returned to the treatment process with the digester supernatant. Considerable nitrification and denitrification were found to occur in all systems and at all temperatures. While nitrification and denitrification decreased with decreasing temperature and sludge age in the continuous feed system, a markedly higher degree of nitrification and denitrification occurred at 5 C than at higher temperatures in the daily feed, manual decant system. Similar trends were observed for the batch systems. Further research with respect to the effects of pH on these nitrogen processes and studies involving a more complete nitrogen balance are recommended. (Carroll-FRC)
W82-06455

NITROGEN DYNAMICS IN WASTE STABILIZATION PONDS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and C. B. Avci.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 361-369, April, 1982. 8 fig, 4 Tab, 22 Ref.

Descriptors: *Nitrogen compounds, *Wastewater treatment, *Stabilization ponds, Mathematical models, Nitrogen removal, Sedimentation, Ammonia.

Nitrogen transformations and removal mechanisms in a waste stabilization pond were investigated via a time-variable model. The relative importances of ammonia volatilization, organism uptake, and sedimentation as nitrogen removal mechanisms were evaluated. The model developed for use in this study is designed to evaluate the percent reduction in waste load which occurs in the stabilization pond, rather than the percent reduction in concentration of pollutants. The primary mechanism of nitrogen removal was found to be the settling of organic nitrogen and subsequent accumulation of non-biodegradable material in the sediment zone. These solids consist of non-living organic material, including bacterial and algal cells. Cell growth results in the conversion of soluble inorganic nitrogen to particulate organic nitrogen, which is removed by sedimentation. Biological activity is the primary mechanism for the removal of ammonia, although ammonia volatilization may contribute to total nitrogen removal at high pH, temperature, and concentrations of ammonia-nitrogen. While some nitrogen removal is achieved through denitrification, the amount of nitrogen removal that can occur through this mechanism is limited by the amount of nitrate introduced into the pond via the influent, which is generally very small. Dynamic models such as the one used in this study can indicate the form of nitrogen or other constituents in the pond effluent. In conjunction with solids removal techniques, this information can be used to develop predictions of overall treatment efficiency and operation and maintenance requirements relating to solids loadings and frequency of filter backwashing. (Carroll-FRC)
W82-06456

INDUSTRIAL WASTES AS CARBON SOURCES IN BIOLOGICAL DENITRIFICATION,
Washington State Univ., Pullman.
J. R. Skrinde, and S. K. Bhagat.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 370-377, April, 1982. 6 Fig, 11 Tab, 17 Ref.

Descriptors: *Denitrification, *Organic carbon, *Industrial wastes, *Biological wastewater treat-

ment, Carbon Methanol, Wastewater treatment, Activated carbon, Anaerobic digestion.

Wastewater contributions of nitrogen, in the form of nitrates, organic nitrogen, and ammonia, have led to eutrophic and toxic conditions in many waterways. Biological nitrification and denitrification appear to be the most promising processes for removing nitrogen from wastewaters. The addition of an organic carbon source, typically methanol, is generally required for denitrification. This study investigated the effectiveness of four industrial waste products (corn silage derivative, excess yeast from a brewery, liquid whey waste from a dairy, and spent sulfite liquor from a paper mill) as alternatives to the relatively expensive methanol. These industrial waste products were all found to be suitable carbon source alternatives and yielded denitrification efficiencies comparable to those observed with methanol. Yeast, methanol, and spent sulfite liquor were found to yield optimum denitrification with a chemical oxygen demand to nitrate-nitrogen ratio of 3 to 1. The rate of denitrification decreased linearly at lower ratios for these three carbon sources. Increased levels of denitrification result in additional 5-day biochemical oxygen demand (BOD) and, to some extent, suspended solids in the effluent. A compromise between desired levels of nitrate and of 5-day BOD in the effluent may be necessary. Denitrification was achieved efficiently and effectively in a fluidized anaerobic activated-carbon system, which required shorter detention times to effect high levels of denitrification than those required by other biological denitrification systems. (Carroll-FRC)
W82-06457

COMPARISON OF BOD RELATIONSHIPS FOR TYPICAL EDIBLE AND PETROLEUM OILS,
Kraft, Inc., Glenview, IL.
J. C. Groenewold, R. F. Pico, and K. S. Watson.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 398-405, April, 1982. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Food-processing wastes, *Biochemical oxygen demand, Grease, *Petroleum products, Industrial wastewater, Rregulations, *Wastewater treatment, Wastewater management, Biodegradability.

Although food processing plant wastes are generally recognized to be completely compatible with sanitary wastewater, many municipalities and sanitary districts have adopted unrealistic regulations with respect to discharges containing nonfloating fats, oils, and greases (FOG). These regulations need to allow for basic differences between petroleum-based fats, oils, and greases and the edible FOG produced by the food industry. A laboratory program was undertaken to measure various wastewater parameters of selected edible and petroleum oils. The average 5-day biochemical oxygen demand (BOD) to FOG ratio for edible oils was about three times higher than the value for petroleum oils. The average 5-day BOD to chemical oxygen demand ratio for edible oils was significantly higher than the accepted values for biodegradable wastes or for petroleum oils. The average BOD rate constant for edible oils was found to be almost twice the value for typical municipal wastewater and over three times that for petroleum oils. No relationship was found between the chain length or degree of saturation of the edible oil fatty acids and the parameters tested. The edible oils stabilized in a shorter time than did petroleum oils. Short-chain hydrocarbons appear to biologically degrade faster than long-chain hydrocarbons and may be easier to treat biologically. The study results clearly demonstrate that edible oils are considerably more biodegradable than petroleum oils and suggest that there should be no limits for edible oils in wastewater discharges other than a prohibition on oils in floating form. (Carroll-FRC)
W82-06458

TYPE A ZEOLITE IN THE ACTIVATED SLUDGE PROCESSES - I: TREATMENT PARAMETERS,
Imperial Coll. of Science and Technology, London (England).
M. J. T. Carrondo, R. Perry, and J. N. Lester.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2796-2806, November 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Phosphorus removal, *Detergents, *Zeolites, *Activated sludge, *Wastewater treatment, Phosphates, Eutrophication, Nutrient removal, Ammonia, Suspended solids, Chemical oxygen demand, Separation techniques.

Phosphate derived from detergent formulations in which sodium tripolyphosphate (STPP) was used as a builder accounted for about 50% of the phosphorus in domestic wastewater. For this reason, reduction of the level of STPP in detergents was seen as a convenient approach to the control of eutrophication of surface waters. An aluminosilicate, zeolite type A, is being considered as a partial substitute for STPP. Removal of zeolite type A in wastewater treatment is carried out by primary settling and activated sludge processes. The compound reportedly aids in sludge settling and has no adverse effects on the activated sludge process. The effects of zeolite type on various wastewater treatment plant parameters were examined at two activated sludge pilot plants. The chemical oxygen demand and suspended solids in the effluents of the test units were not statistically different from the control units. When levels of ammonia, total phosphate and orthophosphate differed significantly between the test and control units, they were usually lower in the test unit than in the control unit. Sludge volume indices also indicate better settleability of the activated sludge in test units compared to control units. (Geiger-FRC)
W82-06459

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,
Camden County Municipal Utilities Authority, NJ.
C. M. Koch, J. G. Stroka, R. K. Perna, and R. E. Foerster.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 339-343, April, 1982. 2 Fig, 10 Tab, 5 Ref.

Descriptors: *Heavy metals, *Sludge, *Wastewater treatment, *Industrial wastewater, Combined wastewater, Combined treatment, Regulations, Sludge disposal, Land disposal, New Jersey.

The Camden County Municipal Utilities Authority is responsible for wastewater management throughout Camden County, New Jersey. A review of existing wastewater treatment plants showed that many were violating water quality standards. The authority recommended that two upgraded and expanded regional wastewater facilities be constructed to treat all wastewater in the Delaware Basin and that three of the existing four plants in the Atlantic Basin be upgraded. An industrial wastewater survey and sampling program was conducted to develop data for a mass balance for heavy metals, with emphasis on seven key metals considered most likely to limit to land application of sludge or sludge products. This mass balance showed that about 70% of the heavy metal loading observed at the 44 existing wastewater treatment plants was contributed by industrial and domestic sources. Industries were the primary sources of cadmium and chromium. The impact of implementing an industrial pretreatment program was estimated using a typical industrial sewer ordinance. In the absence of industrial pretreatment, cadmium is the heavy metal limiting the sludge application rate. Industrial pretreatment could result in removal of 70% of the cadmium in one service area. However, copper would then become the limiting metal restricting the increase in the allowable sludge land application rate to about 10%. It is concluded that the implementation of industrial pretreatment would have only a minor effect on the permissible land application rate for sludge and on the cost effectiveness of land application as a means of sludge disposal, and then only in some areas. (Carroll-FRC)
W82-06461

DEVELOPMENT OF WASTEWATER PURIFICATION IN THE RUHR CATCHMENT AREA AND ITS EFFECTS ON WATER QUALITY IN THE 1970'S (ENTWICKLUNG DER ABWASSERREINIGUNG IM RUHR EINZUGSGEBIET UND IHRE AUSWIRKUNGEN AUF DIE GEWASSERGUTE IN DEN SIEBZIEGER JAHREN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
R. Klopp, H. Herkelmann, and A. Stozek.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 1-16, January 1982. 19 Fig, 5 Tab, 59 Ref. English summary.

Descriptors: *Wastewater treatment, *Biological oxygen demand, *Biological wastewater treatment, *Ruhr river, *West Germany, Activated sludge process, Filtration, Wastewater facilities, Water treatment facilities, Water quality, Municipal wastewater, Effluents.

The results of monitoring investigations into wastewater plants in the Ruhr area of West Germany for the period 1972-1980 are reported in terms of trends in plant construction and in purification, especially in the parameter five-day BOD (BOD). Although the pollution load of inflow remained the same over the reporting period, BOD levels in plant effluents were reduced (median value 30 mg/1 in 1972, 15 mg/1 in 1980; arithmetic mean 60 and 30 mg/1, respectively). For one-stage activated sludge plants, BOD concentration in effluent was reduced by 50% from 1972 to 1976, after which it remained almost constant at about 10 mg/1. Median BOD was reduced from 30 to 16 mg/1 for one-stage percolating filter plants. For all plants, the degree of BOD purification achieved rose from 73% to 85%; for activated sludge plants from 87% to 93% (this was due to a decrease in mean sludge load to 0.3 BOD/kg day or a median of 0.15 kg BOD/kg day). During the reporting period, 32 plants were constructed or rebuilt. In 1972 there were 112 plants, 76 (68%) of which were biological and 36% (32%) chemical. In 1980 the figures were 120, 101 (84%) and 19 (16%). The new plants achieved a BOD purification rate of 96% (mean 7.3 mg/1 BOD in effluent), though they were built to accommodate increased loads and are not always operating to capacity. BOD effluent loads were reduced by 34%, indicating improved water quality over the reporting period. (Gish-FRC)
W82-06469

BENEFICIAL DISPOSAL OF PICKLE LIQUOR,
Great Lakes Steel, Detroit, MI.
J. N. Howell.
Industrial Wastes, Vol 28, No 3, p 21-22, May/June, 1982. 1 Fig.

Descriptors: *Hydrochloric acid, *Phosphorus removal, *Wastewater treatment, *Chemical precipitation, *Steel industry, *Industrial wastewater, Chemical treatment, Sulfuric acid, Phosphates, Industrial wastes, Wastewater disposal, Waste disposal, Detergents, Domestic wastes.

Cooperation between the city of Detroit and the Great Lakes Division of National Steel of Ecorse, Michigan has eliminated two major pollutants from the Detroit River and Lake Erie. The Detroit Sewage Treatment plant began using pickling liquor generated during the production of strip steel to remove phosphates. Testing showed that pickling done with hydrochloric acid rather than sulfuric acid would be less likely to add sulfate ions to the pickling liquor which would pass through the sewage treatment plant and possibly contribute to the pollution of the lake. By May of 1966, pilot tests were concluded showing that iron in the waste pickling acid was forming an iron phosphate compound which would precipitate, removing up to 65% of the phosphate present in raw sewage. In 1968, storage tanks and pipes were erected to store the waste acid. In 1969, provisions were made for phosphorus removal by ferrous chloride until facilities for pickling wastes could be constructed. Results from 1981 show a 75% savings to the city using pickling liquor for phosphate removal rather

than ferrous chloride. The steel mill saves about $160 thousand per month in hauling and waste contracts for disposal of acid wastes. This operation has been working successfully since 1970. (Geiger-FRC)
W82-06486

EXPANDED WASTEWATER TREATMENT AT A METAL WORKING PLANT,
Gilbert/Commonwealth, Jackson, MI.
S. P. Gambhir, and R. Johnston.
Industrial Wastes, Vol 28, No 3, p 14-16, May/June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Design criteria, *Wastewater facilities, *Industrial wastes, *Metal-finishing wastes, Storm sewers, Oil wastes, Separation techniques, Flocculation, Wastewater management, Waste management, Expansion.

Since its startup in 1975, the Saginaw Steering Gear Division of the General Motors Corporation has consistently met or exceeded state standards in its wastewater treatment plant. Wastewater from the plant originates from the cleanup, spillage and blowdown that occurs during plant operation and from tank truck loading docks and coal pile runoff. An onsite wastewater treatment facility and an auxiliary waste sewer were installed, along with a storm and sanitary sewer. Stormwater flows to retention ponds, where it may be inspected before release to an adjacent wildlife management area. The AW treatment plant began operation in 1976 to handle effluent from two manufacturing plants. During plant expansion, a deep sewer and API separators were installed. Unit processes include free oil removal by gravity and emulsified oil removal by pH adjustment, the breaking of organic polymer emulsions, and flocculation by sodium aluminate. Final effluent is monitored for turbidity, oil content and pH. The new plant was fully integrated into an existing facility while assuring reliability, safety and operational flexibility. (Geiger-FRC)
W82-06487

EXPANDING OPTIONS FOR GREYWATER TREATMENT,
Lombardo and Associates, Boston, MA.
P. Lombardo.
Biocycle, Vol 23, No 3, p 45-49, May/June, 1982. 3 Fig, 15 Ref.

Descriptors: *Water reuse, *Wastewater treatment, *Greywater treatment, *Greywater, Septic tanks, Filters, Sand, Reverse osmosis, Biological wastewater treatment, Sedimentation, Chlorine, Disinfection, Iodine, Ultraviolet radiation, Irradiation, Irrigation, Disposal, Compost toilets.

Greywater is defined as all household wastewater except water used for toilet flushing. The use of compost toilets, fairly well accepted in Scandinavian countries, is gaining acceptance only slowly in the United States. Some provision for managing greywater has to be built into all compost toilet systems. Segregating human wastes and greywater in this manner is atrractive for various reasons. Along with its pollution control qualities, a compost toilet reduces household water consumption by about 40%. Greywater can be used or disposed of in a number of different ways. Treatment and reuse schemes discussed include septic tank, sand filtration, rack filtration, biological treatment units, reverse osmosis, sedimentation/filtration, and physical/chemical treament. Three different disinfectants, tablet chlorine, iodine crystals, and ultraviolet irradiation, are particularly useful for preparing treated greywater for either onsite surface discharge, in-the-house reuse, or outside reuse. Greywater may also be treated and disposed of on soil absorption fields, or through irrigation, greenhouse usage, recirculating showers, or suds-savers. (Baker-FRC)
W82-06491

BACTERIA SOLVE PROBLEMS CREATED BY PRISONERS.
Public Works, Vol 113, No 6, p 57, June, 1982.

Descriptors: *Bacteria, *Organic loading, *Shock loads, Wastewater lagoons, Lagoons, Biological oxygen demand, Sodium nitrate, *Wastewater treatment.

The wastewater lagoon system at the Jean, Nevada, prison was upset by the accumulation of grease in the system (caused by non-maintenance of grease traps) and, in a separate incident several months later, by large amounts of powdered milk and rice dumped into the system during a protest. A high pressure jet cleaned the lines of excess grease. Addition of bacteria concentrate (DBC Plus) and sodium nitrate restored the functioning of a lagoon which was very heavily loaded with organic matter (rice and grease). Since these incidents the bacterial supplement has been added on a maintenance basis at the rate of a quarter pound per day. After prisoners introduced diesel fuel into the waste system, a 1 inch layer of oil accumulated on the surface of both ponds. This problem was solved by burning off small areas over a period of a week. (Cassar-FRC)
W82-06505

LOW-COST TREATMENT OF WASTEWATER,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Public Works, Vol 113, No 6, p 52-54, June, 1982. 5 Fig, 6 Ref.

Descriptors: *Sludge lagoons, *Stabilization ponds, *Aeration, *Wastewater treatment, Lagoons, Ponds, Aerated lagoons.

Mechanically simple alternatives to highly technical, complex wastewater treatment systems include aerated lagoons and benthal stabilization ponds. Although these treatment methods are land intensive, they are often applicable in smaller communities that cannot afford complex plants. Multicellular aerated lagoons can consistently produce effluents with both BOD and total suspended solids levels below 30 mg per liter. Power usage is 68% and construction costs are 40% of those for an activated sludge plant of similar size. A desirable depth is 9-12 ft. Either mechanical aeration or air diffusers may be used. Design of aerated lagoons and retention times can be determined according to equations which consider wastewater characteristics and temperatures. Benthal stabilization of waste activated sludge solids takes place in a deposit at the bottom of a water body by anaerobic or anaerobic/aerobic biological processes. The process is stable and odor free as long as the dissolved oxygen level above the deposit is 2 mg per liter or above. Benthal stabilization systems are over 50% cheaper to construct and over 75% cheaper to operate than an aerobic digester system with sandbed drying. Equations are available to compute the pond area (usual depth 18 ft.) from air temperature, wastewater composition, and solids retention time of the activated sludge process. Sludge solids are removed to a land disposal site about once year, usually during a period of high evapotranspiration. (Cassar-FRC)
W82-06506

CONTROLLING SULFIDES AND ODORS IN SEWERS, PART ONE,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and G. A. Whalen.
Public Works, Vol 113, No 3, p 73-76, March, 1982. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Sulfides, *Aeration, *Odor control, *Wastewater treatment, Hydrogen sulfide, Hydrogen peroxide, Pumping stations, Force mains, Sewer systems, Gloucester County, New Jersey, Compressed air.

The Gloucester County (New Jersey) Utilities Authority installed equipment in three pump stations to control sulfides and odors in sewers by force main aeration and hydrogen peroxide treatment. Aeration at 3-15 cfm produces a wastewater low in color and odor, dissolved oxygen of 0.15 mg per liter or more, less than 0.05 mg per liter unionized hydrogen sulfide, low sulfide concentrations, and increased sulfate concentrations. Equipment for aeration consists of air compressors and associated controls. At the Westville station average flow is 0.37 mgd and the minimum daily flow rate is 15,000 gal per hour in a system with a 46,800 gal volume. Detention time is 3.12 hours. Oxygen use for the 3-hour detention period is 36 mg per liter. The safe design concentration is as great as 125 mg per liter for summer peak loading, assuming 40% efficiency. The unit cost of energy is $6.66 per million gal pumped. At Westville the installed cost of the aeration equipment was $13,500, and annual maintenance costs, $750. Hydrogen peroxide alone did not control odor or suppress sulfide formation. Peroxide use at Westville was reduced By 70% after aeration equipment was installed. (Cassar-FRC)
W82-06509

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,
Metcalf and Eddy. Inc., Boston, MA.
W. A. Peterson, R. W. Corneille, and E. T. Garvey.
Public Works, Vol 113, No 3, p 65-67, March, 1982.

Descriptors: *Data storage and retrieval, *Computers, *Wastewater treatment, *Water treatment, Information systems, Records Operations Data Analysis.

A customized time-shared records and operations data system was designed to help water and wastewater treatment plant personnel in handling operational data. This system, Records and Operations Data Analysis (RODA), is individualized for each facility. Highly flexible software allows programming by each facility without major changes in the base program. Although RODA cannot shorten time required for collection and logging of data, it permits ready access to pertinent data in the desired form so that operators can concentrate on optimizing plant operation. Up to 500 individual parameters may be handled at one plant. A typical plant generated 100-150 parameters, has several pages of monthly report, and 10-12 multiparameter trend plots. Samples of the program's menu and different forms of output (performance reports, trent plots) are given. Costs depend on the size of the plant: $1500-$10,000 yearly operating costs, $3000-$7000 professional assistance, $2,000-$3,000 for a computer terminal, and $7,500-$15,000 for startup, customization, and training. (Cassar-FRC)
W82-06511

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,
Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 3C.
W82-06512

NEW BUBBLE DIFFUSERS REDUCE TREATMENT COSTS,
Wheaton Sanitary District, IL.
R. L. Clavel, and M. A. Scalise.
Public Works, Vol 113, No 6, p 46-47, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Aeration, *Energy, *Costs, *Wastewater treatment, *Bubble diffusers, Dissolved oxygen, Wyss Flex-A-Tube diffusers, Diffusers, *Illinois.

The Wheaton Sanitary District in Illinois has reduced energy consumption by 30-40% in its activated sludge plant by installing fine bubble diffusers in one aeration tank. The Wyss Flex-A-Tube diffuser, made by Water Cleaning, Inc., is a flexible plastic tube covering a non-deteriorating frame molded from acetal polymers. The diffusers resistant to fouling by biological growths and internal clogging. Before installation of the diffusers three blowers were generally used. With the diffusers it was possible to operate the system with only one or two blowers, reducing the average monthly power demand from 300 to 198 KW. (Cassar-FRC)
W82-06513

AN ION EXCHANGE PROCESS TO RECOVER NUTRIENTS FROM SEWAGE,
Istituto di Ricerca Sulle Acque, Bari (Italy).
L. Liberti, and R. Passino.
Resources and Conservation, Vol 6, No 3/4, p 263-273, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Ion exchange, *Nutrient removal, Phosphorus removal, Nitrogen removal, Cation exchange, Anion exchange, Wastewater treatment, Resins, Fertilizers, Magnesium ammonium phosphate.

Selective ion exchange was successfully used to recover nutrients from municipal wastewater effluent. The system, containing clinoptilolite in the cation exchange section and a porous Type I quaternary resin in the anion exchange section, removed eutrophicating materials, filtered suspended matter, and partially adsorbed non-biodegradable organic matter. Ammonia removal was 88% and phosphate removal, 89%. After addition of MgCl2 and MgHPO4 the nutrients were recovered as a commercial, insoluble, slow-release fertilizer, MgNH4PO4 x 6H2O. Column regeneration was accomplished with 0.6 M NaCl. Prior to design of a 240 cu m per day demonstration plant, a three column operation with three cationic and three anionic columns connected in series was also operated in continuous fashion, so that two columns were in service at a time while the third column was being regenerated. (Cassar-FRC)
W82-06516

BIOLOGICAL PROCESSES FOR CONCENTRATING TRACE ELEMENTS FROM URANIUM MINE WATERS,
New Mexico Bureau of Mines and Mineral Resources, Socorro.
C. L. Brierley, and J. A. Brierley.
New Mexico Water Resources Research Institute, Report No 140, December 1981. 93 p, 1 Fig, 26 Tab, 76 Ref, 1 Append.

Descriptors: *Pollutants, *Inorganic compounds, *Mine drainage, *Mine wastes, *Wastewater treatment, *Uranium, *Selenium, *Molybdenum, Ponding, Resins, Tailings, Algal growth, Waste treatment facilities, Filters, Solubility.

New Mexico's uranium and molybdenum mine operations must remove large amounts of inorganic agents from their waters, but current methods are often ion specific and expensive. The objective of this study was to assess the role of biological agents in removal of inorganic trace contaminants from uranium mine wastewaters. The Kerr-McGee Corporation, using two mines, has developed a treatment process for water. Particulates are settled by ponding, and the waters are passed through an ion exchange resin to remove uranium; barium chloride is added to precipitate sulfate and radium from the mine waters. The waters then pass through three consecutive algae ponds prior to discharge. Water sediment and biological samples were collected and analyzed over a 4-year period. Some conclusions derived from these analyses are: the concentrations of soluble uranium, selenium and molybdenum in the waters were not diminished by passage through the treatment facility's impoundments; the mine water's particulate concentrations were reduced about ten-fold by passage through the impoundments; the ponds were well oxygenated; the pH was near normal indicating that the major soluble species of trace contaminants are molybdate, uranyl carbonate species and selenite; plant microbial life can remain viable at 10 degrees C. or higher; conentrations of phosphate and nitrate were high enough to support some algal and microbial activity; the sediments wee anoxic; the algae act as bio-filters for accumulation of particulate pollutants in ponds; and stimulation of algal growth and increased pond size are necessary for effective removal of trace contaminants. (Atkins-Omniplan)
W82-06520

EFFECT OF UV LIGHT DISINFECTION ON ANTIBIOTIC-RESISTANT COLIFORMS IN WASTEWATER EFFLUENTS,
Environmental Protection Agency, Cincinnati, OH.
M. C. Meckes.
Applied and Environmental Microbiology, Vol 43, No 2, p 371-377, Feburary, 1982. 7 Tab, 34 Ref.

Descriptors: *Coliforms, *Ultraviolet radiation, *Activated sludge process, Effluents, *Wastewater treatment, Escherichia coli, Antibiotics, Disinfection, Antibiotic resistance, Resistance factors, Transferable resistance.

Wastewater, both treated and untreated, is a major contributor of bacteria to the aquatic environment. Several studies have shown that significant numbers of multiple drug-resistant coliforms occur in rivers, bays, bathing beaches, and coastal canals. This is a source of considerable concern, since bacteria carrying transmissible R-factors are capable of transferring antibiotic resistance to antibiotic-sensitive bacteria, raising the potential for transfer of antibiotic resistance to pathogenic species. The effect of ultraviolet (UV) light disinfection on antibiotic resistant coliforms in municipal wastewater effluents was investigated. Total coliforms and total coliforms resistant to streptomycin, tetracycline, or chloramphenicol were isolated from filtered activated sludge effluents before and after UV light irradiation. The wastewater effluent was effectively disinfected by the UV irradiation, but the percentage of the total surviving coliform population resistant to tetracycline or chloramphenicol was significantly higher than the percentage of the total coliform population resistant to those antibiotics prior to treatment. UV treatment did not affect the percentages of coliform resistant to streptomycin. Analysis of the multiple drug resistance patterns of 300 total coliform isolates revealed that 82% were resistant to two or more antibiotics. In addition, 46% of these isolates were capable of transferring antibiotic resistance to a sensitive strain of Escherichia coli. (Carroll-FRC)
W82-06532

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,
Technion--Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 5C.
W82-06538

AQUACULTURE FOR WASTE MANAGEMENT,
Nebraska Univ., Lincoln. Dept. of Agronomy.
L. Cchesnin.
Biocycle, Vol 23, No 3, p 52-55, May/June, 1982. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Reviews, *Aquaculture, Wastewater management, Wastewater disposal, Water resources development, Fish farming, Fish, Nutrients, Sludge disposal, Aeration, Lagoons, Ponds, Microbial degradation, Biodegradation.

The current status of aquaculture research in the area of waste resource utilization indicates that a significant though largely untapped potential exists for the production of aquatic protein for human and animal consumption. Findings from various studies investigating the utilization of animal wastes have indicated that fish production was 1.8 times greater when manure was introduced directly into the environment as compared to supply only manure-grown algae as a feed source, that fish had a beneficial effect on water quality in ponds receiving wastes from two lots of pigs insofar as dissolved oxygen and BOD were concerned, that fish grew well in ponds receiving wastes from pig pens, that greater productions of Chinese carp and freshwater prawns were obtained in a polyculture system when the ponds were supplied fresh swine manure than when supplied with aged swine manure, and that inputs of manure and commercial feed has similar protein yield relationships in hybrid tilapia production. The incresed use of human wastes and sewage for fish production depends mainly on public acceptance. Studies have shown that human to fish ponds have resulted in higher yields than in ponds supplied with commercial fish feeds. Sewage treatment ponds stocked with fish had higher dissolved oxygen concentrations and pH than similar ponds without fish. Industrial wastes, such as distillers' wet grains, were successfully fed to fish and crayfish as the only source of food. With sufficient aeration and retention time for microbial decomposition it would appear that high biological oxygen demand organic wastes could be used to provide the substrate for a polyculture aqatic system. (Baker-FRC)
W82-06556

FRENCH PREMIERE FOR WASTEWATER DISINFECTION USING OZONE.
World Water, Vol 5, No 5, p 43-44, May, 1982.

Descriptors: *Ozone, *Disinfection, *Wastewater oxidation, *Wastewater treatment, Tertiary wastewater treatment, Guethary, *France.

The first French wastewater treatment plant to use ozone for final disinfection is Guethary, a resort town on the Atlantic Ocean. The plant handles a population equivalent of 1250 in winter and 13,000 in summer. Since effluent is discharged into the ocean in the bathing area, it is necessary to remove biological pollution completely. The treatment process is activated sludge with prior clarification-flocculation during the tourist season. Tertiary treatment is provided by a rapid gravity sand filter. The ozone dose is 10 g per cu meter of effluent treated. (Cassar-FRC)
W82-06607

METAL REMOVAL 'A LA CARTE',
For primary bibliographic entry see Field 5F.
W82-06608

THE ROLE OF ELEMENTAL OXYGEN DEMAND IN TOTAL OXYGEN DEMAND FOR WATER POLLUTANTS,
Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima, T. Ishizuka, and H. Sunahara.
Water Research, Vol 16, No 6, p 1003-1009, June, 1982. 1 Fig, 7 Tab, 5 Ref.

Descriptors: *Oxygen demand, *Water quality, Industrial wastewater, Nitrogen, Oxygen, Water pollution control, Biochemical oxygen demand, Wastewater treatment.

The fundamental relationship between total oxygen demand (TOD) and elemental oxygen demand (EOD) for various organic and inorganic compounds in water was studied using a total organic carbon (TOC)-TOD analyzer and a TN (total nitrogen) analyzer on the influent and effluent in an activated sludge pilot plant. The EOD values of carbon and nitrogen in the constituent units of water pollutants were measured, and the relative TOD levels were discussed. The COD/TOD and NOD/TOD ratios of several organic compounds, proteins, and microbes in activated sludge were above 0.6 and below 0.25, respectively. However, in the effluent of a pilot plant the NOD/TOD value was larger than the COD/TOD value, indicating the NOD plays a more important role in the TOD value than in the COD value. The concept of EOD can also be used to characterize the TOD of pollutants in environmental waters such as river water, lake water and other water bodies. (Baker-FRC)
W82-06611

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),
For primary bibliographic entry see Field 8C.
W82-06633

INVESTIGATIONS ON LOADING AND QUALITY OF DISCHARGE OF MUNICIPAL SEWAGE TREATMENT PLANTS IN THE CASE OF STORMWATER INFLOW (UTERSUCHUNGEN UBER BELASTUNG UND ABLAUFBESCHAFFENHEIT KOMMUNALER

KLARANLAGEN BEI MISCHWASSERZUFLUSS),
Bayerisches Landesamt fuer Wasserwirtschaft, Muinich (Germany, F.R.),
P. Schleypen, and P. Wolf.
Wasserwirtschaft, Vol 72, No 2, p 53-59, February, 1982. 7 Fig, 5 Tab, 5 Ref. English summary.

Descriptors: *Municipal wastewater, *Storm wastewater, *Suspended solids, *Biological oxygen demand, *Chemical oxygen demand, Activated sludge process, *Wastewater treatment, Pollutants, Percolating filters, Wastewater lagoons, Biological wastewater treatment, Water law, *West Germany, Design standards, Hydraulic engineering.

Inflow, BOD, COD, and suspended solids were examined at 21 West German municipal biological wastewater treatment plants in dry and rainy weather to determine whether the plants could handle the increased demands made by stormwater. The facilities comprised two two-stage biological plants, one nonaerated sewage pond, three percolating filter plants, and six activated sludge plants with and six without presettling. Results showed that in rainy weather an increase in plant discharge of five-day BOD and COD with respect to dry weather must be expected. This increase is insignificant when measured over 24 hours, but over a 2-hour period a mean increase of 30% for five-day BOD may occur. Stormwater created an increased hydraulic demand on the plants, leading to an increase in the pollution load of their discharge of 2.5-3 times of that in dry weather when hydraulic load was increased twofold. For the mean values measured, percolating filter and activated sludge plants performed similarly, but percolating filter plants performed less well for maximum values due to operating problems in the control of filter loading and postsettling-basin size. Activated sludge plants with low capacity loading are capable of handling stormwater because of their large buffer volume. Sewage ponds of adequate dimensions behave in a similar fashion to activated sludge plants with low loads. With the exception of sewage ponds, suspended solids concentration in the discharge of municipal plants can increase greatly in rainy weather even where postsettling conforms to standard. A change in water law is therefore necessary, and this should double the permissible level of suspended solids in discharge when stormwater is being processed. This is prudent for technical, operational, and economic reasons. (Gish-FRC)
W82-06634

HOW MUCH AIR,
Montgomery (James M) Inc., Pasadena, CA.
M. L. Arora.
Water/Engineering and Management, Vol 129, No 7, p 43-44, 47, June, 1982. 2 Fig, 5 Tab.

Descriptors: *Aeration, *Activated sludge proces, *Oxygen transfer, Design criteria, Temperature effects, Altitude, *Wastewater treatment, Oxygenation, Dissolved oxygen.

Several approaches are available for calculating the air requirements and aeration system horsepower for activated sludge systems. First the theoretical field condition requirements are computed. Then these are converted to standard conditions (20 C liquid temperature, zero mg per liter dissolved oxygen in the aeration basin, sea level, and tap water). The effects of several parameters on aeration equipment performance are discussed. Alpha, the relative rate of oxygen transfer in wastewater as compared to tap water, is a function of the type of waste and the type of aeration equipment. It varies from 0.4 to 1.0. Higher values of alpha reduce the required horsepower. Surfactants and fine bubble diffusers tend to lower alpha values. Beta, the relative oxygen saturation value in wastewater as compared to clean water under standard conditions of temperature and altitude, is strictly a function of the type of waste. Higher values are beneficial. For normal domestic sewage the range of beta values is 0.8 to 0.95. Oxygen concentration is often overdesigned. A 2.0 mg per liter concentration during normal operation or 1.0 mg per liter during short-term peak loads is satisfactory. Higher air and wastewater temperatures can significantly decrease oxygen saturation concentrations. This condition, as well as the higher oxygen uptake ratios at higher temperatures, must be considered in designing equipment. Altitude effects are similar to temperature effects. For example, a plant at 7000 ft altitude may require 877 horsepower vs 610 horsepower for a sea level plant for 1000 lb per hour aeration equipment, providing other conditions are the same. (Cassar-FRC)
W82-06638

PAC PROCESS,
Zimpro, Inc., Rothschild, WI.
J. A. Meidl.
Water/Engineering and Management, Vol 129, No 7, p 33-36, June, 1982. 4 Fig, 4 Tab.

Descriptors: *Activated carbon, *Activated sludge process, *Wastewater treatment, *Powdered activated carbon, Zimpro, Incorporated, Costs, Organic compounds, Priority pollutants, Sludge, Nitrogen removal, Oxygen transfer, Disinfection, Odor control.

Patents on use of powdered activated carbon (PAC) in the aeration tank of the activated sludge system were developed by DuPont and purchased by Zimpro, Inc. Since 1977 the system has been used for treating a diverse range of wastewaters in plants of 500 kl to 54 mgd capacity. The wet air regeneration process recovers 95% of the carbon with no dewatering or added heat. There are several advantages to the PAC process: improved organics (including priority pollutants) and nitrogen removal; and reduced sludge volume index, power requirements (up to 20%), disinfection requirements, and sludge quantity. In addition, odor control costs are minimized. The process' status as an innovative technology allows 10% extra EPA funds. The process using wet air regeneration is cost competitive with conventional activated sludge treatment and granular activated carbon treatment. Design guidelines and experiences at operating plants are discussed. (Cassar-FRC)
W82-06643

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,
Northumbrian Water Authority (England).
For primary bibliographic entry see Field 5E.
W82-06645

MICROSTRAINER THEORY AND THE FILTRABILITY INDEX OF SEWAGE EFFLUENTS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
J. A. Anderson.
Water Pollution Control, Vol 81, No 1, p 120-126, 1982. 7 Fig, 9 Ref.

Descriptors: *Filtration, *Secondary wastewater, *Suspended solids, *Wastewater treatment, Solids contact processes, Mathematical equations, Process efficiency.

Microstraining refers to the mechanical separation of solids from liquids resulting from the passage of a secondary effluent through a porous fabric having apertures of less than 100 microns. The filtrability of a fluid is a function of the fluid, the suspended solids, and the filter medium. Boucher (1947) introduced the term 'filtrability index', which relates the head loss across the microstrainer to the flow rate. The error inherent in this previously accepted equation is demonstrated through a discussion of the theory of microstrainers. A simple piece of equipment, marketed under the name Filtester, can be used to measure the filtrability index. This equipment produces a filtrate almost identical to that obtained from an operating microstrainer, which can be analyzed for suspended solids and biochemical oxygen demand removal efficiences. Effluents from biological filters, humus tanks, and rapid gravity sand filters were used to investigate measurement of the filtrability index. The results of these tests demonstrated a strong correlation between the filtrability index and the concentration of suspended solids removed by the microstrainer. The correlation between the suspended solids removal efficiency and the ratio of filtrability index to the suspended solids concentration in the effluent was not as strong. The Filtester was found to provide a simple and inexpensive means for assessing the performance of a proposed microstrainer installation with respect to any given effluent. Microstrainers can be used effectively for tertiary treatment only if the suspended solids in the secondary effluent are present in the form of easily filterable floc particles. Factors which may affect the removal of suspended solids include particle size, particle shape and structure, shear resistance, and compressibility. (Carroll-FRC)
W82-06647

PILOT-SCALE ADVANCED WASTE-WATER TREATMENT AT DAVYHULME,
North West Water Authority (England).
T. E. Wallbank, and T. A. Parry.
Water Pollution Control, Vol 81, No 1, p 127-141, 1982. 9 Fig, 9 Tab, 22 Ref.

Descriptors: *Pilot plants, *Advanced wastewater treatment, Experimental design, *Wastewater facilities, Physicochemcial treatment, Biological treatment, Cost analysis, Process efficiency, Effluents, *United Kingdom, Davyhulme.

An advanced wastewater treatment pilot plant was constructed at the Davyhulme works in the United Kingdom to evaluate the use of physicochemical and biological processes in various combinations, to investigate the potential for production of effluents suitable for industrial reuse, and to determine the cost benefits of these processes. The principal experiments conducted during the 5-year study are summarized. Flocculation of crude sewage with lime was found to significantly increase the removal of suspended solids in primary sedimentation, reducing the biochemical oxygen demand loading on the subsequent biological stage. Settled sewage having a pH value as high as 11.5 could be treated successfully by the activated sludge process. Primary lime dosing to pH 10 removed about 80% of the suspended solids, while using lime to pH 9 plus aluminum sulfate achieved slightly better results at marginally higher costs. Tertiary treatment by dual-media filtration and granular activated carbon resulted in production of high quality effluents, perhaps suitable for industrial reuse. Primary lime treatment appeared to slightly enhance the activity of nitrifying microorganisms in two completely-mixed activated-sludge units. Considerable variations were found in the conditioner types and dose rates required for mechanical dewatering of the chemical and biological sludges produced by the plant. The performance predictions developed by using data from the plant in the sewage treatment optimization model were found to be accurate over a wide range of flows. (Carroll-FRC)
W82-06649

PERFORMANCE OF ROTATING BIOLOGICAL CONTACTORS UNDER FIELD CONDITIONS,
Water Research Centre, Stevenage (England).
E. B. Pike, C. H. Carlton-Smith, R. H. Evans, and D. W. Harrington.
Water Pollution Control, Vol 81, No 1, p 10-27, 1982. 4 Fig, 7 Tab, 54 Ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, Industrial wastewater, *Performance evaluation, Wastewater composition, Wastewater oxidation, On-site studies, *Rotating biological contactors.

Factors affecting the performance of commercial rotating biological contactor units installed at wastewater treatment facilities were investigated. Specific factors found to adversely affect performance at units in facilities serving small communities included organic overloading and mixing of liquors between treatment units. Performance was best at the two facilities which had two and three stages of disks in series and which had separate primary treatment and humus settlement units, suggesting that characteristics tending to plug-flow were de-

sirable in the disk compartment. The sets of data for composition of sewage and effluents were distributed approximately log-normally, and, for sets of samples taken throughout treatment, the variance of biological oxygen demand and suspended solids was related to the arithmetic mean by a power law. If this relationship is general, it could be used to calculate percentile values for any given mean value of effluent quality for use in performance modeling. A two-year study of a 30-population-equivalent unit found that on the average performance and rates of treatment were greater, and sludge production was lower in the year when flow varied over a diurnal cycle than in the year of operation with steady flow at a uniform average rate. The results of analysis of variance tests suggested that attempts to reduce variability in effluent quality on a daily basis should not be undertaken without a critical assessment of the temporal components of variability at the facility. (Carroll-FRC)
W82-06650

ESHOLT--PAST, PRESENT AND FUTURE,
Yorkshire Water Authority (England). Western Div.
J. O'Neill.
Water Pollution Control, Vol 81, No 1, p 28-36, 1982. 4 Fig.

Descriptors: *Wastewater treatment, *Industrial wastewater, History, Wool scouring, *Textile mill wastes, *Dye industry wastes, Wastewater facilities, Municipal wastewater, Combined wastewater, Combined treatment, Bradford, *United Kingdom.

The city of Bradford, England has been a center of the textile and wool-combing industry since the early part of the 19th century. The city constructed sewers in 1862, which removed the wastes from the town's environs but resulted in serious pollution of the River Aire. The first waste treatment facilities were established in 1872. Waste treatment facilities constructed by the city in 1912 included a sludge presshouse for the treatment of sludge from chemical precipitation of combined wastewater with sulfuric acid. Over the next 50 years, the Esholt wastewater treatment facility was expanded to include precipitation tanks, biological filters, detritus and storm-sewage tanks, humus tanks, a clarification lake, and grease recovery facilities. In 1973, a multiple-hearth sludge incinerator was added. Changes in the wool industry have resulted in a 90% decrease in the amount of grease recovered at Esholt. However, the sewage treated, which gets about 60% of its organic load from industry, remained strong. A complete re-evaluation of the treatment facility in 1977 resulted in a decision to discontinue sludge processing and dewatering operations and to replace these with sludge consolidation followed by disposal of liquid sludge either to the land or to the sea. This change in operations resulted in a significant improvement in effluent quality, primarily as the result of improved settlement and the change of the bacteriological environment of the filter beds from acidic to nonacidic. (Carroll-FRC)
W82-06653

RECOVERY OF PROTEIN AND OIL FROM FISHERY BLOODWATER WASTE, EFFECT OF PH AND TEMPERATURE,
Instituto Nacional de Technologia Industrial, Mar del Plata (Argentina).
E. M. Civit, M. A. Parin, and H. M. Lupin.
Water Research, Vol 16, No 6, p 809-814, June, 1982. 7 Fig, 2 Tab, 39 Ref.

Descriptors: Fisheries, *Wastewater treatment, *Industrial wastewater, *Proteins, *Oils, Acidity, *Temperature effects, *Hydrogen ion concentration, Heat treatment, Coagulation.

The study investigated the conditions of temperature and optimum pH for protein coagulation and oil recovery from fisheries bloodwater. Information about the variation of the chemical oxygen demand (COD) of the effluent and about the kind of proteinaceous material recovered and remaining in solution was also obtained. Heating must be carried out above 65 degrees C, but temperatures above 75-80 degrees C will not improve recovery. The optimum range for the adjustment of pH was between 5.6-5.9. The maximum reduction in COD was found in the same temperature and pH ranges. The combination of heating and pH adjustment was shown to be more effective than each process by itself. Delay in processing increased the non protein nitrogen and diminished the protein recovery and the COD reduction. (Baker-FRC)
W82-06655

CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF SEWAGE EFFLUENTS, IS LONG TERM PERFORMANCE A LIMITING FACTOR,
Portsmouth Polytechnic (England). Dept. of Civil Engineering.
B. A. Winfield.
Water Research, Vol 16, No 6, p 797-799, June, 1982. 2 Fig, 7 Ref.

Descriptors: *Reverse osmosis, *Membranes, *Membrane processes, Membrane filters, *Wastewater treatment, *Cellulose acetate membranes.

The performance of cellulose acetate reverse osmosis membranes was examined in the treatment of secondary sewage effluents over a three year period. A commercially available 'spaghetti' type unit was used for the study. This unit was fed with pH adjusted (5.5-6.0) secondary sewage effluent during normal operation. It was flushed monthly with a 0.5% formaldehyde solution. The exposure of the membranes to sewage treatment conditions produced changes in their performance which differed markedly from anything which had been anticipated. The observed increase in permeability for the sulfate ion was 1.5 times and for the sodium ion 1.2 times. Observed trends in water permeability also deviated from the predicted behavior. Hydrolysis should result in an increase in water flow per unit area, while in fact the reverse occurred. Thus any loss of permselectivity is likely to be minimized by the deposition of fouling over porous regions of the membrane created by hydrolysis and also microbiological activity. Another effect of the deposition of fouling over imperfect regions of the membrane is that it effectively contributes to a loss of the active membrane surface. (Baker-FRC)
W82-06657

RECOVERY OF CHROMIUM(VI) FROM WASTEWATERS WITH IRON(III) HYDROXIDE-I. ADSORPTION MECHANISM OF CHROMIUM(VI) ON IRON(III) HYDROXIDE,
Osaka Prefecture Univ. (Japan). Coll. of Engineering.
T. Aoki, and M. Munemori.
Water Research, Vol 16, No 6, p 793-796, June, 1982. 7 Fig, 12 Ref.

Descriptors: *Wastewater treatment, *Chemical reactions, *Chromium, *Iron, Hydroxide, Adsorption, Metals, Ion exchange, Anion exchange, *Hydroxides.

The mechanism of chromium(VI) adsorption on iron(III) hydroxide was investigated. As pH decreased, the coprecipitation of Cr(VI) with iron(III) hydroxide increased; no coprecipitation occurred above a pH of 8.5. An increase in the coprecipitation also occurred with an increase in the amount of iron(III) hydroxide. When the suspension (pH 4.5) containing ironIII hydroxide was mixed with a solution (pH 4.5) containing Cr(VI), the pH of the mixed suspension increased and became constant after 20-30 minutes. When the suspension of pH 4.5 stood for a month, its pH decreased from 4.5 to 3.8, and a small percent of Cr(VI) was desorbed from the iron(III) hydroxide. The decrease of pH was not due to carbon dioxide from the air. Thus it is assumed that the oxolation of iron(III) hydroxide caused a decrease in pH over time. To formulate the forces governing the exchange between adsorbed HCr04(-) and other anions, desorption of Cr(VI) was examined in the presence of various anions. Desorption of HCr04(-) increased with increase of the added anion. It appeared that the main factor governing adsorption of the anions is ion bonding and a specific chemical bonding with the surface of the iron(III) hydroxide. The adsorption of Cr(VI) was increased in the presence of metal ions because the positive charge due to adsorption of metal ions on iron(III) hydroxide increased and attracted HCr04(-) to the surface of iron(III) hydroxide and because the metal hydroxides partially formed below pH 8.5 and increased anion exchangeable sites. (Baker-FRC)
W82-06658

THE KINETICS OF OZONE-PHENOL REACTION IN AQUEOUS SOLUTIONS,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
M. G. Joshi, and R. L. Shambaugh.
Water Research, Vol 16, No 6, p 933-938, June, 1982. 3 Fig, 4 Tab, 30 Ref.

Descriptors: *Ozonation, *Kinetics, Chemical reactions, *Phenols, Water pollution, *Ozone, *Wastewater treatment, Laboratory studies, Oxidation, Chlorination, Industrial wastewater, Coal gasification.

Rate constants were determined for the reaction of ozone and phenol in water. Careful account was made of the mass transfer of ozone from gas phase to aqueous phase, and the effect of pH and various soluble salts on the rate constant for phenol ozonation was studied. Rate constants were determined for the solid catalyzed reaction of ozone and phenol in water using four different catalysts. Initially a few experiments were carried out to check for mass transfer limitations. In these experiments only the flow rate of ozone-oxygen mixture fed to the reactor was varied, keeping everything else the same. The results indicated that mass transfer resistance was not likely to be a limiting factor. The effects of the pH of the reaction mixture, the solid catalysts, and the presence of certain solutes in the reaction mixture on the reaction kinetics were also investigated. The study concluded that the reaction of ozone with phenol in aqueous solution can be adequately represented by a second order rate equation and does not involve hydroxide ion radicals. The catalysts which are effective in the oxidation of aqueous phenol by molecular oxygen are not effective in enhancing the rate of ozonation of aqueous phenol. Hence, the mechanism of ozonation is quite different from that of oxidation with simple oxygen. (Baker-FRC)
W82-06661

INFLUENCE OF MULTICELLULAR CONFIGURATIONS ON ALGAL GROWTH IN AERATED LAGOONS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 6, p 929-931, June, 1982. 3 Fig, 7 Ref.

Descriptors: *Aerated lagoons, *Algal growth, Aeration, Lagoons, Anaerobic lagoons, Eutrophication, *Wastewater treatment, *Municipal wastewater.

The combined influence of the multicellular configuration and retention time on algal growth in aerated lagoons is considered. In lagoons treating domestic wastewaters, growth is controlled by light and carbon dioxide. Beyond the first cell in a dual-power level system, light penetration is relatively uniform from cell to cell due to the low and equal levels of aeration employed in that part of the lagoon system. The carbon dioxide concentration will also be relatively uniform from cell to cell. In an experiment aimed at calculating the annual mean concentrations of suspended solids in the effluents of two polishing pond systems receiving a secondary effluent from a domestic wastewater treatment plant, one system consisted of a single cell and the other of four cells in series. At retention times less than 2 days, the effluent suspended solids from both systems decreased as a result of sedimentation of suspended solids in the secondary effluent; the subsequent increase reflected the generation of algae in the pond systems. The increase in effluent suspended solids occurred at a

much greater rate in the single cell system than in the four cell system. The difference in performance can be explained in terms of the hydraulics of an ideal system. Only 6.2% of the effluent from the three cell system has a retention time greater than twice the average retention time, as compared with 13.5% for the single-cell system. For a four-cell system, the percentage drops to 4.2. This reduction in the percent of effluent with long retention times is responsible for the suppressive effect on growth which was noted. (Baker-FRC)
W82-06662

DERIVATION OF AN EMPIRICAL SORPTION RATE EQUATION BY ANALYSIS OF EXPERIMENTAL DATA,
Colorado State Univ., Fort Collins. Dept of Civil Engineering.
D. W. Hendricks, and L. G. Kuratti.
Water Research, Vol 16, No 6, p 829-837, June, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Sorption, *Mathematical equations, Regression analysis, Kinetics, Model studies, Mathematical models, Continuous flow, Filters, Packed beds, Reactors, *Wastewater treatment.

In this work five postulated sorption rate equations are tested in terms of their fits to experimental data. The data were generated by sorption uptake tests in batch reactors. The range of experimental conditions included two sorbate-sorbent combinations, four temperatures, and 30 initial concentrations of sorbate, giving a total of 240 tests. A sorption uptake curve was plotted for each experimental test; the rate coefficients for the five rate equations were determined by the differential method from the uptake curves. The fits of the different rate coefficients plotted against solution concentrations were evaluated by visual indication of scatter and by regression analysis. Through this screening process the validity of one of the equations was ascertained. Uptake rate was dependent on degree of sorbent saturation with sorbate and liquid phase sorbate concentration. The rate equation verified above was documented over a wide range of experimental conditions. The equation is a basis for routine lab tests of sorption uptake with time. The coefficients for the particular system of interest can be obtained from these tests. Further work is needed to ascertain the validity of the equation over a broad range of hydrodynamic conditions. The larger goal is to ascertain an easy to use kinetic model which has application in reactor design. (Baker-FRC)
W82-06664

DYNAMICS OF BIOFILM PROCESSES: METHODS,
Montana State Univ., Bozeman. Coll. of Engineering.
W. G. Characklis, M. G. Trulear, J. D. Bryers, and N. Zelver.
Water Research, Vol 16, No 7, p 1207-1216, July, 1982. 10 Fig, 5 Tab, 40 Ref.

Descriptors: *Biofilms, *Bacteria, Measuring instruments, *Wastewater treatment, Laboratory studies, On-site studies.

This paper reviews methods for measuring biofilm development processes in the laboratory and in the field. Two reactor geometries were used to study biofilm development and destruction. The circular type was used, as it is the prevalent geometry in heat exchangers. The rotating annular reactor was also tested because of its compactness and ease of operation. Direct measurement of biofilm quantity is essential in calibration of indirect measurement techniques for determining biofilm quantity, in the use of mass conversion equations for determining process rates and stoichiometry, and in relating biofilm development to fluid frictional resistance and heat transfer resistance in a rational manner. Indirect measurement of biofilm quantity using a specific biofilm constituent has certain advantages, including the facts that some of the indirect methods are more sensitive, and that indirect measures provide information regarding biofilm composition and hence stoichiometry of biofilm processes. Indirect measurement of biofilm quantity through microbial activity within the biofilm is useful in certain instances, such as in determining the physiological state of the organisms in the biofilm, in some measurements of biofilm activity which are extremely sensitive, and in substrate removal rates which are needed when employing mass conservation equations. The choice of analytical method for monitoring biofilm processes will be dependent on the questions which prompt the investigation. (Baker-FRC)
W82-06666

THE BEHAVIOUR OF NITRILOTRIACETIC ACID DURING THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
Imperial Coll. of Science and Technology. London (England). Public Health Engineering Lab.
P. W. W. Kirk, J. N. Lester, and R. Perry.
Water Research, Vol 16, No 6, p 973-980, June, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Anaerobic digestion, *Nitrilotriacetic acid, Chelating agents, Sludge digestion, Sludge, Digestion, Biodegradation, Anaerobic conditions, Activated sludge process, *Wastewater treatment, Land disposal, Sludge disposal.

The fate of nitrilotriacetic acid (NTA) in anaerobic digesters fed with mixed primary sludge was investigated. Each of four digesters was initially seeded with 1 liter fresh digested sludge and 0.5 liters of mixed primary sludge. Subsequent additions consisted of mixed primary only, diluted with distilled water. Two sequential additions of 1.5 g calcium hydroxide were made to each digester on days 6 and 8. From days 12-24 prolonged purging of the digester was undertaken with oxygen-free nitrogen following each addition of influent sludge. After stabilization periods of 50 days, NTA was spiked into three digesters to produce concentrations of 10, 20 and 30 mg/liter in the digesting sludge. All subsequent feeds to these three digesters contained NTA concentrations of 10, 20 or 30 mg/liter respectively. The percentage removal of NTA from solution during anaerobic digestion decreased with increasing influent concentration. Addition of sodium azide, which prevented anaerobic degradation of the volatile solids, did not increase soluble NTA concentrations in the digesters, indicating that the removal observed was not the result of biodegradation. It was apparent that the current widespread application of anaerobic digestion in sewage treatment would result in a large percentage of any NTA present passing through this treatment unaffected, with unknown consequences for the application of this sludge to agricultural land. (Baker-FRC)
W82-06667

APPARATUS FOR CLEANING WATER CONTAINING FOREIGN PARTICLES SUCH AS SUSPENDED MATTERS OR OIL,
H. Ino, and R. Ino.
U.S. Patent No 4,203,849, 7 p, 14 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 989-990, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Oil pollution, Suspended solids, Equipment.

The object of this invention is to provide an apparatus for cleaning water which is characterized by a number of inclined partition plates that are placed in a container at regular intervals in such a way that the plates are slanted with respect to the horizontal and vertical planes. The basic principal lies in the fact that the separation chamber is separated by partition plates into a number of oblique passages which make the settling distance (that is the distance the particles travel before settling on the plates) of the suspended particle short and which also changes the direction of movement of the suspended particles relative to the direction of the water so that the suspended particles are completely separated from the water. (Sinha-OEIS)
W82-06699

FERRATE ION: POTENTIAL USES IN ADVANCED WASTEWATER TREATMENT,
Nebraska Univ., Lincoln. Dept. of Chemistry.
J. D. Carr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256751, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Report, June, 1982, Lincoln, Nebr. 39 p, 5 Fig, 5 Tab, 10 Ref. OWRT A-053-NEB(3), 14-34-0001-9029.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Iron, *Oxidation, *Kinetics, *Organic compounds, Wastewater, Organic wastes, Wastes, Organic matter, Organic loading, Oxidized wastewater, Oxidation process, Wastewater oxidation, Chemical oxygen demand, Spectrophotometry, Spectral analysis, Iron compounds, Chemical analysis, Water analysis.

The potential use of ferrate (VI) ion in the treatment of industrial wastewater containing particularly objectionable organic compounds in the absence of a high biochemical oxygen demand was explored. The oxidation kinetics of a variety of aqueous organic solutes by ferrate (VI) ion and the identification of potential reaction products were carried out. Kinetic measurements were made by visible spectrophotometry at conventional and stopped-flow speeds. The oxidation of water by ferrate (VI) occurs by two parallel pathways; one being first-order in ferrate (VI); the other being second-order. The former (and its pH dependence) was interpreted in terms of the rapid decomposition of H2Fe04; the latter, in terms of the rapid decomposition of Fe207 divalent anion. Both species are transient intermediates which are directly unobservable due to their short lifetimes. A new method for interpreting mixed-order kinetics was developed. Iron (II) was unexpectedly observed as an intermediate in the reduction of iron (VI) to iron (III). The overall conclusion of these studies was that there are many situations where ferrate (VI) can be used to advantage in wastewater decontamination, especially in industrial situations in which specific objectionable organics are produced in the presence of a low biochemical oxygen demand. The oxidation kinetics of nitrilotriacetic acid, aliphatic alcohols, ammonia and alkylamines, ethylene glycol, cyanide, phenol, and diethyl-sulfide are reported. (Zielinski-MAXIMA)
W82-06701

PILOT PLANT STUDIES OF COPPER, ZINC, AND TRIVALENT CHROMIUM REMOVAL BY ADSORBING COLLOID FOAM FLOTATION,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256827, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 88, August, 1981, Knoxville. 74 p, 7 Fig, 20 Tab, 31 Ref. OWRT A-064-TENN(1), 14-34-0001-1145.

Descriptors: *Industrial wastewater, *Metal-finishing wastes, *Copper, *Zinc, *Chromium, *Wastewater treatment, Wastewater, Heavy metals, Industrial wastes, Colloids, Gels, Flotation, Foam separation, Hydraulic loading, Trace metals, Coagulation, Chemical coagulation, Water treatment, Adsorbents, Adsorption.

Design parameters were considered for adsorbing colloid foam flotation (ACFF) for treating metal finishing industry wastewaters. Combinations of copper, zinc, and chromium (III) were studied, as well as the effects of pH, hydraulic loading rate, coagulant and surfactant doses, ionic strength, and air flowrate on metal removal. These data led to the development of mathematical expressions relating coagulant dose with metal removal. The study results indicated that ACFF is a feasible method for treating heavy metal-bearing wastewaters. Coagulant doses of about 100 mg/liter lowered metal concentrations from 20 mg/liter at optimum pH (7.0-7.6) and low ionic strength (below 0.05), to

0.1-0.5 mg/liter. Hydraulic loadings up to 15 cu m per sq m per hour. Economic analysis of the ACFF process indicated it to be less expensive than alkaline precipitation. The ACFF process found to be simple and rapid, requiring low space and energy for operation, and yielding small concentrated sludge volumes. The low residual metal levels consistently achieved were below currently mandated regulatory effluent standards, as well as the 1984 BAT-equivalent guidelines. (Zielinski-MAXIMA)
W82-06708

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W82-06709

INVESTIGATIONS INTO THE NITRIFICATION OF SYDNEY'S WASTEWATERS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
P. J. Bliss, D. Barnes, and B. A. Windshuttel.
Effluent and Water Treatment Journal, Vol 22, No 4, p 137-140, 142-143, 145, April, 1982, 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Nitrification, *Design criteria, *Activated sludge process, *Wastewater treatment, Sydney, *Australia, Retention time, Dissolved oxygen, Oxygen, Ammonium, Seasonal variation, Aeration.

Design requirements for nitrification in the activated sludge process were studied in full-scale runs at the Castle Hill treatment plant in Sydney, Australia. Mean cell residence time requirements to initiate nitrification were 20 days for winter (13-14 C) and 4 days in summer under optimum conditions: dissolved oxygen of 4-5 mg per liter and flow equalization (peak-to-average ammonium ratios less than 1.7). These conditions produced an effluent with ammonium concentrations of 2 mg per liter average and 5 mg per liter peak. Higher effluent ammonium concentrations resulted under transient loads or at lower dissolved oxygen levels. At high mixed liquor suspended solids concentrations, solids were lost in the clarifier effluent. A pH range of 6.5-8.0 was suitable for nitrification. For a optimal design of nitrifying activated sludge plants the system components must be balanced. For example, the design mean cell residence time and aeration tank volume are minimal at higher (4-5 mg per liter) dissolved oxygen concentrations and with flow equalization. However, the higher dissolved oxygen requires a larger aeration system, and flow equalization requires larger storage capacity. At higher mixed liquor suspended solids concentrations the aeration tank volume may be reduced, but the clarifier capacity must be increased. There is also evidence that sludge settleability is reduced at high dissolved oxygen concentrations. (Cassar-FRC)
W82-06724

PUT PRESSURE ON SEWAGE,
Greenhorne and O'Mara, Inc., Riverdale, MD.
L. N. Rydland.
American City and County, Vol 97, No 6, p 47-48, June, 1982.

Descriptors: *Sewar systems, *Wastewater collection, *Septic tanks, *Wastewater treatment, Pumps, Rural areas, Grinder pumps, Pressure sewer systems.

Pressure sewer systems are available to convey sewage from rural homes with faulty on-site disposal systems to establish sewer networks. The septic tank effluent pump (STEP) system consists of a receiving tank, a pump, control sensors, piping, and valves. The grinder pump (GP) system has a grinder, pump, check valve, automated controls, holding tank, and venting system. In the STEP system the existing septic tank must be intact and working properly; otherwise it is removed or bypassed. The GP system involves a totally new on-lot installation. It eliminates reliance on septic tanks, requires less property disruption and piping, and pumps aerobic, rather than anaerobic, sewage to the treatment plant. (Cassar-FRC)
W82-06732

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,
Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
For primary bibliographic entry see Field 5A.
W82-06734

EVIDENCE THAT MICROORGANISMS CAUSE INACTIVATION OF VIRUSES IN ACTIVATED SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 5, p 1221-1224, May, 1982. 2 Fig, 26 Ref.

Descriptors: *Activated sludge process, *Viruses, *Wastewater treatment, Poliovirus, Microorganisms, Wastewater disposal, Waste disposal, Land disposal, Microbial degradation, Microbiological studies.

The role played by microorganisms in virus removal during activated sludge treatment was investigated. Mixed-liquor suspended solids (MLSS) of activated sludge were seeded with a standard enteric virus, and the loss of virus plaque-forming units (PFU) was measured over time. The virus used was the LSc2ab strain of poliovirus 1. The first experiment was done to determine the effect of MLSS on the recovery of poliovirus after different periods of incubation. The results indicated a rapid decrease in recoverable PFU occurring during the first 16 hr of incubation, relative to a control. The second experiment was done to determine the role of different MLSS components in virus loss. The MLSS were centrifuged, the supernatant was removed, and the pellet was suspended in an equal volume of distilled water. This suspension and the supernatant fraction were then seeded witn poliovirus. The loss of recoverable PFU was at least as rapid in the suspended pellet as in the original MLSS. The supernatant fraction intitially had almost no effect on virus recovery, but the expression of antiviral activity in this material became evident within 48 hr and progressed steadily through the 13 day incubation period. The third experiment was done to measure the effects of different disinfection methods on the antiviral activities in the pellet and supernatant fractions. Results indicated that MLSS contain a component which inactivates poliovirus, most likely a microorganism or group of microbial species. The identity of this organism, the mechanism by which it decreases poliovirus recovery, and its effect on other enteric viruses remain to be determined. (Baker-FRC)
W82-06739

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,
Kurita Water Industries Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 5A.
W82-06743

ISOLATION OF ENTEROVIRUSES FROM OXIDATION POND WATERS,
University of Southern Mississippi, Hattiesburg. Dept. of Microbiology.
V. L. Sheladia, R. D. Ellender, and R. A. Johnson.
Applied and Environmental Microbiology, Vol 43, No 4, p 971-974, April, 1982. 1 fig, 2 Tab, 14 Ref.

Descriptors: *Viruses, *Oxidation lagoons, Ponds, Enteroviruses, *Wastewater treatment, Oxidation, Lagoons, Seasonal variations, Aeration, Chlorination.

Enteroviruses were isolated from two types of oxidation lagoons. One lagoon complex involved 140 hectares of surface area, average input of 8000000 gallons/day, a retention time of 98 days, and effluent biological oxygen demand and suspended solids of 1,070 and 1,859, respectively. The other lagoon complex was smaller and processed a lower volume, employing mechanical aeration as well as effluent chlorination. Together the complexes serve about 45,000 people in primarily a light industrial area. During the 18 month study isolations, performed by sewage concentration and direct assay, were low in number and did not follow a seasonal trend. The newer treatment system, using aeration and effluent chlorination, was more efficient at removing viruses than the older, static complex. (Baker-FRC)
W82-06750

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, and B. Koopman.
Applied and Environmental Microbiology, Vol 43, No 4, p 964-966, April, 1982. 3 Fig, 16 Ref.

Descriptors: *Bacteria, *Activated sludge, Bacterial analysis, Sludge, Wastewater treatment, Activated sludge process, Chlorination, Wastewater analysis, *Pollutant identification, *Tetrazolium.

Bright-field microscopy and a new staining technique were used for the examination of the activity of filamentous bacteria in activated sludge after chlorine addition. A continuous-flow activated-sludge unit consisting of a 20-liter aeration basin with an integral clarifier was seeded with activated sludge culture from a wastewater treatment plant. The assessment of the activity of filamentous bacteria involved the incubation of activated sludge with 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride, followed by staining with malachite green. Both cells and 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride-formazan crystals can be observed in prepared specimens by using bright field microscopy. This method allowed the distinction to be made between inactive and actively metabolizing filaments after chlorine application to control the bulking of activated sludge. The procedure is simple, eliminates the use of epifluorescence, and allows the observation of inactive and active cells. (Baker-FRC)
W82-06752

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,
Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-06757

SEWER RENEWAL BY PIPE INSERTION.
For primary bibliographic entry see Field 8A.
W82-06759

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, and O. W. Prozesky.
Water Research, Vol 16, No 6, p 823-828, June, 1982. 4 Fig, 1 Tab, 31 Ref.

Descriptors: Water quality, *Reclaimed water, Drinking water, *Water reuse, *Wastewater renovation, Water supply development.

The quality of drinking waters originating from secondary effluents was investigated using the cloning efficiency technique. A comparison was made between direct and indirect reuse of wastewater in terms of their comparative efficiencies in removal of toxicants. Indirect reuse of wastewater was tested by investigating a system in which secondary effluents are discharge into a

river flowing into an artificial reservoir. After conventional treatment, water from this reservoir was supplied as potable water. Direct reuse was tested by studying the removal of toxicants by the unit processes in a water reclamation plant. Various stages of both the direct and indirect reuse systems were tested in order to determine which stage resulted in the greatest removal of toxicants. Judging from the results obtained by using the tissue culture cloning efficiency technique for testing both direct and indirect reuse of treated wastewater, both purification processes proved equally effective in removing most of the toxicants originally present in the secondary treated wastewater. The study suggests that reclamation of wastewater for direct reuse in arid regions can solve the problem of water shortages without increasing the health hazard to the consumer. (Baker-FRC)
W82-06768

THE KINETICS OF HEXAVALENT CHROMIUM REDUCTION BY METALLIC IRON,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould.
Water Research, Vol 16, No 6, p 871-877, June, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Chromium, Industrial wastes, Cooling towers, *Kinetics, Chemical reactions, *Iron, Chemical reduction, Oxidation-reduction potential.

The use of metallic iron as a reductant for Cr(VI) is reported. Metallic iron reacted efficiently with Cr(VI) under acid conditions in a complex reaction. Reaction kinetics were 0.5 order in both hydrogen ion and hexavalent chromium and first order in iron surface area. Since the iron consumed is proportional to the Cr(VI) concentration, careful system design will obviate the need for measuring and dispensing various treatment chemicals. Substantially less iron is needed to reduce a given quantity of Cr(VI) than would be the case for Fe(2+). In effect, each iron molecule provides 1.5-2.5 electrons in the reduction rather than the single electron available from the ferrous iron. The highly efficient utilization of iron in the reduction suggests that hydrogen generated during iron dissolution may be acting as a reductant for the Cr(VI). Since iron utilization efficiency improves as Cr(VI) concentration increases, such a treatment system implies that a significant advantage will be associated with segregation of high concentration Cr(VI) bearing wastes. The resulting effluent containing ferric ion and the relatively non-toxic chromic ion might be usable as a coagulant where needed. (Baker-FRC)
W82-06771

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Enginerring.
R. M. Kabrick, and W. J. Jewell.
Water Research, Vol 16, No 6, p 1051-1060, June, 1982. 4 Fig, 4 Tab, 38 Ref.

Descriptors: *Pathogens, *Sludge digestion, *Digested sludge, Bacteria, Coliforms, Viruses, Parasites, Wastewater treatment, Salmonella, Pseudomonas, Anaerobic digestion, Thermophilic digestion, Mesophilic digestion.

The effect of two types of sludge digestion on pathogen survival was studied in two full-scale, continuous systems: autoheated aerobic thermophilic digestion and conventional mesophilic anaerobic digestion. The aerobic digester was operated at 45-65 C and variable loading conditions. the anaerobic digester was operated at a constant temperature of 35 C and constant loading rates. Mean bacterial counts per 100 ml of wet sludge were: feed sludge, 37 million fecal coliforms and 27 million fecal streptococci; anaerobic sludge, 840,000 fecal coliforms and 930,000 fecal streptococci; and aerobic sludge, 18,000 fecal coliforms and 82,000 fecal streptococci. The aerobic digester reduced Salmonella sp. to nondetectable levels and pseudomonads to lower levels except for one sampling date on which the digester was operating poorly. The anaerobic digester reduced Salmonella sp. and pseudomonads less efficiently. The aerobic digester reduced viruses to the nondetectable level, and the anaerobic reduced viruses as much as 98.6%. The aerobic process did not completely eliminate parasitic ova, but it was more effective than the anaerobic process. The thermophilic aerobic digester can be improved by using series-fed reactors or sequencing batch units to compensate for inadequate temperatures during start-up or shut-down. (Cassar-FRC)
W82-06772

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 5G.
W82-06775

EFFECT OF CARBON-OXYGEN AND CARBON-SULFUR SURFACE COMPLEXES ON THE ADSORPTION OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS BY ACTIVATED CARBONS,
Universidad Nacional de Educational a Distancia, Madrid (Spain).
J. de D. Lopez-Gonzales, C. Moreno-Castilla, A. Guerrero-Ruiz, and F. Rodriguez-Reinoso.
Journal of Chemical Technology and Biotechnology, Vol 32, No 5, p 575-579, May, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Carbon, *Adsoprtion, *Wastewater treatment, *Mercuric chloride, Chlorides, Acidity, *Activated carbon, Water treatment, Temperature effects.

The adsoprtion of mercuric chloride from aqueous solution onto activated carbons previously treated to introduce carbon-oxygen and carbon-sulfur surface complexes was studied to determine their effect on the adsorptive capacity of the original carbons. The findings demonstrated that the existence of hydroquinone, phenolic and hydrosulfide groups on the surface of the carbon caused reduction of Hg(II) to Hg(I). However, there was an increase in the adsorption of Hg(II) when sulfide or hydrowulfide groups were present on the surface of the carbon. The effect of the pH of the solutions on mecuric chloride adsorption was also studied. When the pH was changed from 1 to 7 the adsorption of mercuric chloride by the activated carbons was enhanced. (Baker-FRC)
W82-06788

ELECTROPLATING AND CYANIDE WASTES,
Virginia Poly..chnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and J. Kunjur.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6 p 733-737, June, 1982. 45 Ref.

Descriptors: *Literatuure reviews, *Electroplating, *Metal-finishing wastes, *Cyanide, wastes, Industrial wastewater, *Wastewater treatment, Metals, Heavy metals, Regulations, Chemical precipitation, Sludge dewatering, Sludge disposal, Chromium, Copper, Nickel, Zinc, Membrane processes, Wastewater analysis, Ozonation, Aeration, *Reviews.

A review of recent literature on electroplating and cyanide wastes included several topics: regulatory aspects, heavy metals treatment and recovery, cyanide detection and treatment, and sludge treatment and disposal. In general, effluent standards became less stringent and more flexible during 1981. Some compliance dates were extended, and pretreatment standards for electroplaters generating less than 38,000 liters per day of waste flow were established. Many papers concerned heavy metals treatment. Among the newer or better methods mentioned were carbonate precipitation, soluble sulfide precipitation, amine ligands for Cu and Ni precipitation, sodium hydroxide precipitation, sodium borohydride, electrocoagulation, reverse osmosis, ultrafiltration, and adsorption on a confined soil bed. Developments in cyanide determination included the use of sodium ethylenediamine tetraacetic acid for masking interfering ions, polarographic methods for low levels (< 0.1 mg per liter) of cyanide, and automatic monitoring of cyanide and other wastewater constituents. Cyanide waste treatment methods discussed were high temperature and high pressure hydrolysis to convert cyanide to ammonia and formate, use of iron sulfide compounds, percolation through mixed pyrrhotite-pyrite, oxygen/hydrogen catalytic treatment, fixed bed columns containing ceramic material or graphite, ozonation, and hydrolytic assist extended aeration. Sludge treatment and disposal innovations were a new silicate material for concentrating sludge, use of sludge as an admixture for concrete, metals immobilization by acid fixing in a proprietary siliceous polymer and solidification in cement, and immobilizing chemicals such as lanthanum compounds, Magnesium chromate, ferrite sludges, and a carbonate/silicon oxide mixture. (Cassar-FRC)
W82-06798

STEEL INDUSTRY WASTES,
Canada Centre for Inland Waters, Burlington (Ontario).
D. T. Vachon, J. W. Schmidt, and N. W. Schmidtke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 729-733, June, 1982. 61 Ref.

Descriptors: *Steel industry, wastes, *Literature reviews, *Metal-finishing wastes, *Industrial wastes, *Reviews, *Wastewater treatment, Coke, Biological treatment, Water reuse, Nitrification, Thiocyanates.

A review on the characteristics and treatment of steel industry wastes included general papers and reports on coke production, iron and steel making and forging, pickling operations, and metal finishing processes. An additional $10 billion in pollution control equipment is projected for this industry by 1989. As effluent limitations become more stringent, the cost effectiveness of control measures decreases. Recycling and recirculation are becoming increasingly important. Research on wastewater from coke production effluents concerned alkaline chlorination with filtration and dechlorination, thiocyanate removal by ion exchange, ozonation, treatment with long chain quaternary amines to remove iron cyanides, stripping in a distillation tower, removal of oil and grease with coagulation/flocculation/dissolved air flotation/caustic soda treatment, biological treatment, biological nitrification, use of activated carbon in nitrification/denitrification, and mixing at 10% with municipal wastewater. Several processes were successful in treating blast furnace gas cleaning wastewater, steel manufacturing wastewater, pickling effluents, and metal processing wastes.(Cassar-FRC)
W82-06799

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
M. F. Torpy, and E. L. Stover.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 726-729, June, 1982. 2 Tab, 30 Ref.

Descriptors: *Literature reviews, *Oil shale, *Synthetic fuels, *Coal gasification, *Reviews, Fuel, Toxicity, Water pollution effects, Wastewater analysis, Biological treatment, Tar sands, Waste disposal, Fate of pollutants, *Wastewater treatment.

A review of synthetic fuel effluents and their impact on water quality reveals that several meetings and symposia included information on this subject. Several waste stream treatment methods were mentioned--a separate biological nitrification unit to handle high thiocyanate levels, ammonia stripping, solvent extraction, and wet air oxidation. Coal liquefaction products were more toxic to

fresh water algae than shale oil products and petroleum products. Topics in the field of oil shale and tar sands were studies: the wet scrubbing system; water reuse options; adsorption of retort water by soil; chemical characterization of effluents, up to 238 constituents identified; methods of determining ammonia; mobility of trace elements; treatment of wastewater by biological treatment, reverse osmosis, or evaporation; mutagenicity of effluents; solids disposal problems; migration of organic constituents through the soil; and vegetative stabilization of retorted shales. (Cassar-FRC)
W82-06800

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and M. F. Torpy.
Journal of the Water Pollutin Control Federation (Literature Review Issue), Vol 54, No 6, p 723-726, June, 1982. 52 Ref.

Descriptors: *Literature reviews, *Oil refineries, *Hydrocarbons, *Industrial wastes, *Wastewater treatment, Petroleum products, Oil industry, Oil wastes, Organic compounds, Membrane processes, Oil shale, Activated carbon, Coagulation, Land disposal, Sludge, Water polution prevention, *Reviews.

Recent work on the environmental effects and treatment of petroleum processing wastes was reviewed. Characterization of wastewater effluents showed that priority pollutants were associated with certain products and processes that use certain precursors and generic process combinations. Sour condensates from conventional crude oil cracking produced straight chain alkanes, and pyridines and anilines were present in shale oil sour condensates. Heavy metal levels were low in most process effluents. The oil/water separation techniques data base has been updated by the American Petroleum Institute to include 166 citations. New papers in this field concerned the use of flocculation and flotation, electrochemical purification, electroflotation-coagulation, and an emulsion breaker/alum system. Biological wastewater treatment plants at several refineries were described. Special topics included carbon dioxide treatment of spent alkalis in refinery wastewater to decrease phenols and sulfur compounds and use of activated carbon. Several papers discussed the special problems of shale oil wastewater. Methds of protecting streams and groundwater in tar sands regions included monitoring, toxicity testing, and spill prevention. Petroleum refinery wastewaters were also treated by several membrane processes. Sludges were handled by solidification with hydrophobically adjusted Ca-containing chemicals, reuse in sealants and roofing or as fuel, and land disposal and microbial degradation. (Cassar-FRC)
W82-06801

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
T. W. Siegrist.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 737-749, June, 1982. 152 Ref.

Descriptors: *Literature reviews, *Chemical wastewater, *Industrial wastewater, *Organic compounds, *Reviews, Wastewater treatment, Activated carbon, Adsorption, Phenol, Polychlorinated biphenyls, Chlorinated hydrocarbons, Incineration, Biodegradation, Pesticides, Physicochemical treatment, Metals, Oxidation, Surfactants, Activated sludge process, Biological treatment, Drugs, Encapsulation, Nitrification, Microorganisms, Ultrafiltration, Membrane processes.

A review of recent literature on wastewater treatment in the chemical industry was organized according to product type and type of treatment (source, biological, and physical/chemical). For treating phenol and mixtures the following techniques were tried: anaerobic granular activated carbon bioreactors, anaerobic fixed-film bioreactors packed with granular activated carbon, carbon-sulfur compounds, liquid membranes, electrochemical oxidation, and horseradish peroxidase and hydrogen peroxide. Polychlorinated biphenyls and related chlorinated compounds were degraded or removed by incineration, chemical dechlorination, ultraviolet-ozone treatment, ultraviolet-light irradiation, polyurethane foam filtration, a particulate elastromeric polymer, algae, and microorganisms. Pesticides production wastewaters were treated by microbial degradation and a variety of chemical techniques specific to the nature of the wastewater. In addition papers on treatment of wastewaters from paint and ink plants, pharmaceutical manufacture, chlorinated organic wastes, detergent manufacture, and dozens of miscellaneous organic chemicals were summarized. Many waste products were recovered, some for sale, from process streams, for example, recovery of naphthalene hydrocarbons from petrochemical wastewater by adsorption on activated carbon and recovery of dispersed elemental Hg used as the oxide as a catalyst in vinyl acetate production by treatment with hydrazine hydrate. Biological treatment, especially with adapted activated sludges, was used for many chemicals. Powdered activated carbon, closed pure oxygen systems, and genetically-engineered microorganisms were among the modifications to the activated sludge process. Many studies were done on the factors affecting the activated sludge process. (Cassar-FRC)
W82-06805

SIMPLIFIED CLARIFIER AXES TREATMENT STAGES,
World Water, Vol 5, No 5, p 22-23, 25, May, 1982. 6 Fig.

Descriptors: *Clarification, *Oxidation ditches, *Biological treatment, *Wastewater treatment, Little Blue Valley Sewer District, Jackson County, *Missouri, Pilot tests, Design criteria, Land application, Aeration, Aerobic digestion, Dewatering, Sludge disposal.

The Little Blue Valley Sewer District biological sewage treatment plant in Jackson County, Missouri, was ranked as one of 1982's ten outstanding engineering achievements by the National Society of Professional Engineers. The 5000 cu m per day pilot plant uses only 6 of 13 originally planned treatment components to reduce costs to a minimum. The unconventional process comprises screening, oxidation ditch with integral clarification device, sludge waste pump, aerobic digester with integral clarification device, sludge dewatering, and land application. The heart of the simplified system is an intrachannel clarification device which eliminates the secondary clarifier and the secondary return sludge pump and piping. A section of the oxidation ditch opposite the aerator is deepened and partially blocked to force the normal ditch flow downwards, creating a quiescent zone for clarification. V-section cross pieces isolate the quiescent zone from the normal mixed liquor flow beneath, allowing mixed liquor to pass upward through the sections. Sludge falls back into the mixed liquor flow. Effluent is drawn from near the surface of the quiescent zone. Further experience showed that the grit removal step was also unnecessary. Average effluent BOD5 is 10-25 mg per liter with detention times as low as 6 hours. (Cassar-FRC)
W82-06820

THE REMOVAL OF MIXTURES OF METALS BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 683-693, April, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Flotation, *Metals, *Foam separation, *Separation techniques, Industrial wastewater treatment, *Wastewater treatment, Zinc, Copper, Chromium, Heavy metals, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation, Aluminum hydroxide, Ferric hydroxide, Economic analysis, Costs, Lime, Chemical precipitation.

A foam flotation pilot plant removed Cu(+++), Zn(++), and Cr(3+) from a simulated industrial wastewater containing 20 mg per liter each of these ions. At optimal conditions the residual levels of the ions were: Cu, < 1 mg per liter; Zn, 0.5 mg per liter; and Cr, 0.2 mg per liter. Hydraulic loading rates were 6.9 cu m per sq m per hour; air flow rate, 14 N cu m per sq m per hour; pH, 7.0-8.0; Fe(3+) as a flocculant, 100-115 mg per liter; Al(3+) as a flocculant, 75-100 mg per liter; and sodium lauryl sulfate foaming agent, 25-30% of total Fe and Al dose by weight. Economic analysis showed that adsorbing foam flotation could remove metals at a cost of 51 cents per 1000 liters vs. 60 cents per 1000 liters for a lime precipitation plant. This did not include the expensive filtration step and the 8 times greater area required for the lime precipitation process. (Cassar-FRC)
W82-06821

REMOVAL OF ZINC BY ADSORBING COLLOID FOAM FLOTATION: PILOT PLANT STUDY,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 673-682, April, 1982. 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Flotation, *Foam separation, *Separation techniques, *Metals, *Zinc, Copper, Aluminum hydroxide, Hydraulic loading, Heavy metals, Industrial wastewater treatment, *Wastewater treatment, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation.

A foam flotation pilot plant removed zinc from a simulated industrial wastewater containing 20 mg per liter Zn(++). Effluent Zn concentrations were below 1 mg per liter when the following optimum parameters were used: pH, 7.5-7.8; Al(3+) as aluminum hydroxide, 100 mg per liter; sodium lauryl sulfate surfactant, 30-40 mg per liter; hydraulic loading rate, 6.9-13.8 cu m per sq m per hour; and air flow rate, 12-13 N cu m per sq m per hour. Optimum Al(3+) dose depended on the influent Zn(++) concentrations. To produce effluent Zn(++) concentrations of < 1 mg per liter, a 50 mg per liter Al(3+) dose was sufficient for influent Zn(++) of 10 mg per liter concentration, and 150 mg per liter Al(3+) was necessary for influent Zn(++) of 30 mg per liter. Substituting Fe(OH)3 for Al(OH)3 and Cu(++) for Zn(++), trends were similar but residual Cu(++) was lower. Increasing ionic strength above 0.05M was detrimental to Zn(++) removal. (Cassar-FRC)
W82-06822

CONTINUOUS DENTRIFICATION BY IMMOBILIZED CELLS (DENITRIFICATION EN CONTINU A L'AIDE DE MICROORGANISMES IMMOBILISES SUR DES SUPPORTS SOLIDES),
Departement de Genie Biochimique, Tolouse (France).
M. Vossoughi, M. Laroche, J. M. Navarro, G. Faup, and A. Leprince.
Water Research, Vol 16, No 6, p 995-1002, June, 1982. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Denitrification, *Wastewater treatment, Nitrates, Nitrogen, Nitrification, Kinetics, Chemical reactions, Colorimetry, *Biological wastewater treatment, Pseudomonas, Bacteria.

A study of biological denitrification by immobilized cells is described. Nitrates are reduced in sterile solutions by Pseudomonas aeruginosa immobilized in a fixed bed reactor, and in synthetic wastewater by mixed cultures immobilized in a fluidized bed reactor. The fixed bed reactor was a Plexiglas column filled with corn stovers. Nitrates and nitrites were determined by a colorimetric method. The reactor efficiency remained constant for over 40 days. Nitrates and nitrites were measured inside the reactor for flow varying from 2 to 16 ml/minute. Reductions of nitrates and nitrites seem to be two first-order reactions, and the constant rate increases with flow rate. The fluidized bed reactor used was a Plexiglas column filled with earthenware. The reduction of nitrates and nitrites

again appeared as two first-order reactions, and the constant rate values, higher than in fixed bed reactors, increased with flow. The reactor was more greatly affected by a flow shift than by a nitrate concentration shift in fresh medium; the biomass bound to the carrier was about 76 mg of dry matter/g of earthenware. The fluidized bed column was able to reduce 560 mg of nitrate nitrogen/hr/liter of empty reactor, with a liquid retention time of less than 3 minutes. (Baker-FRC)
W82-06830

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
York Univ. (England). Dept. of Biology.
N. V. Ashley, M. Davies, and T. J. Hurst.
Water Research, Vol 16, No 6, p 963-971, June, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Anaerobic digestion, *Nickel, Microorganisms, *Biological treatment, Digestion, Biodegradation, Anaerobic conditions, Sludge digestion, Activated sludge process, *Wastewater treatment, Water pollution effects, Metals, Heavy metals.

The effects of increased nickel ion concentrations on physiological groupings of microorganisms were examined to determine the toxic effects upon the degradative populations of bacteria in an anaerobic digester and to estimate a realistic toxic level of nickel in a population of organisms adapted to it by prolonged exposure at relatively low concentration. The concentration of dissolved nickel remained low (0.35 to 1.1 mg/liter) following addition of nickel at 25 and 50 mg/liter to the digester feed, presumably due to much of the nickel being present as the sparingly soluble sulfide or otherwise bound. At progressively higher additions (100, 150 and 250 mg/liter) the dissolved nickel increased substantially, probably due to a depletion in the available sulfide levels caused by the earlier nickel addition. The maximum dissolved nickel level obtained was 15 mg/liter. The nickel had exerted appreciable toxicity below this concentration. The nickel level in the control digester never exceeded 0.2 mg/liter. There appeared to be only a slight increase in relative numbers of acid producing organisms in the digester at low nickel additions, more so at a level of 50 mg/liter. The populations of amylolytic bacteria exhibited an initial increase in relative number with changes in nickel additions, followed by a decrease in number. Apart from these growth-stimulating effects at initial addition, the major effect of nickel was to lower the amylolytic bacterial populatic n to a level below that of the control digester. The populations of proteolytic organisms were generally higher in the nickel challenged digester than in the control. A marked increase in the proleolytic population was found with the addition of 100 mg/liter of nickel, after which the population decreased, only to increase again under the influence of a further nickel increase. Nickel apparently favors a degradative population of bacteria primarily adapted to amino acid fermentation and inhibits carbohydrate metabolism in a population of proteolytic and amylolytic bacteria. (Baker-FRC)
W82-06832

BASIC STUDIES ON CARBON DIOXIDE/AIR CONTROL SYSTEM FOR ACTIVATED SLUDGE PROCESSES,
Hitachi Ltd., Ibaragi (Japan).
S. Nogita, S. Watanabe, and K. Baba.
Water Research, Vol 16, No 6, p 1017-1024, June, 1982. 14 Fig, 6 Tab, 4 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Carbon dioxide, Oxygen, Dissolved oxygen, Sludge, Municipal wastewater, Aeration tanks.

Basic facts about the production of carbon dioxide by activated sludge in an aeration tank are summarized, and the experimental results obtained with a carbon dioxide/air control system are reported. A continuous-flow-type apparatus was used to gather the data. Under the given conditions of the experiment the composition of the inflow and the air flow rate had little effect on the carbon dioxide production rate of activated sludge, and the carbon dioxide production rate was a function of the organic load. Since the organic load change caused a change in the carbon dioxide production rate in minutes instead of hours, a carbon dioxide/air control system in an activated sludge pilot plant was used to study carbon dioxide production. A control system was developed which effectively stabilized the carbon dioxide concentration. It was concluded that a carbon dioxide/air control system that can maintain a dissolved oxygen concentration within 0.5 mg/liter of a selected value functions in the same way as a dissolved oxygen/air control system, when exhausted air is analyzed in the former system. The system tested maintained the carbon dioxide concentration within 0.000.5 vo1% of a selected value with a typical diurnal sewage flow rate pattern and maintained the dissolved oxygen content in mixed liquor within 0.4 mg/liter of a selected value. (Baker-FRC)
W82-06833

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,
California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
P. S. K. Leung, and N. J. Sell.
Water Resources Bulletin, Vol 18, No 3, p 495-502, June, 1982. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Water quality, *Pulp and paper industry, *Pulp wastes, Industrial wastes, Fox River, *Wisconsin, Water pollution sources, Water pollution control, Biological oxygen demand, Suspended solids, Dissolved oxygen, Toxicity, Organic chemicals, *Wastewater treatment, Primary wastewater treatment, Secondary wastewater treatment.

Eighteen paper mills, producing greater than 5300 tons of paper per day, located along the Lower Fox River, Wisconsin, were asked to participate in a study of the effectiveness of the waste treatment methods each employed. Nine plants agreed to participate. On-site visits were made and discussions held with appropriate management and operating personnel. Technical data regarding the general operation of the plant, water pollutants, and methods for primary and secondary treatment were included in the study. In general the paper companies without any pulping processes or which produce relatively small quantities of paper per day either install only the primary treatment system or send the waste stream to a nearby municipal system. Companies with pulping processes or large quantities of paper being produced usually also install a secondary treatment system. Primary treatment is basically a settling pond. The overall efficiencies of these primary treatment systems are about 95% and 30-55% for removing suspended solids and BOD, respectively. Secondary treatment in all cases consisted of activated sludge systems, including an aeration tank where most of the microbiological activity occurs and a secondary clarifier where the activated sludge settles out. The maximum temperatures of the discharges reached 110 F, although most effluents ranged from 70 to 90 F. All plants discharged only about 40-50% of the allowable suspended solids. Similarly, most discharged less than 50% of the allowable BOD. Even so, the water quality of the river, particularly as regards dissolved oxygen, remains unsatisfactory at times. Several types of regulatory changes are possible. Flow and temperature related permits would probably be the most effective in improving DO levels, but would also be the most difficult to comply with. (Baker-FRC)
W82-06870

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-06890

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Calocerinos and Spina Co., Liverpool, NY.
P. E. Moffa, S. D. Freedman, E. M. Owens, R. Field, and C. Cibik.
Journal of the Water Pollution Control Federation, (Literature Review Issue). Vol 54, No 6, p 675-677, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Urban runoff, *Combined sewer overflows, *Storm water, *Reviews, Model studies, Detention basins, Water management, Storm wastewater, Wastewater treatment, Rainfall, Monitoring, Water quality, Trace metals, Copper, Lead, Zinc, Settleable solids.

A review of urban runoff literature dealt with characteristics, impacts on receiving waters, control, treatment, and management. The great variability of storm water quality was handled by some simplified modeling and monitoring techniques and other methods of estimating pollutant levels and impact on receiving waters. Snowmelt was lower in nutrients, but higher in total solids, oil and grease, and colloidal material, than was rainfall runoff. It was estimated that combined sewer overflows and surface runoff contribute 30% of BOD and 74% of suspended solids discharged from municipal sources. Models and planning methods were also developed for aiding in design of storm water storage and treatment systems. Treatment considerations included underground circulation systems, facultative lagoons, biological treatment, sewer flushing, polymer injection, flow regulations, and upstream storage. In settleability tests hydrocarbon, lead, and total suspended solids were reduced by 70% over 32 hours; BOD, Cu, and Ni settled more slowly, 20-50% in the same time; and Zn settled the slowest. Methods of estimating flow rates for managing storm water flows included use of digital recording weather radar, computer based models, and statistical techniques. (Cassar-FRC)
W82-06914

TEXTILE WASTES,
Krebs (Paul B.) and Associates, Inc., Birmingham, AL.
J. F. Judkins, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 702-704, June, 1982. 25 Ref.

Descriptors: *Literature reviews, *Industrial wastewater, *Textile mill wastes, *Dyes, *Wastewater treatment, *Reviews, Wool scouring, Polymers, Ultrafiltration, Membrane processes. Textiles, Fabrics, Wool, Dye industry wastes, Ozonation, Activated sludge process, Flocculation, Chemical coagulation.

Recent literature on treatment and disposal of textile wastes described processes for handling dyeing wastewaters, wool scouring effluents, synthetic fiber wastewaters, and polymeric sizing agents. Good results were obtained from unspecified textile wastewaters by alum coagulation, followed by activated sludge treatment and by powdered activated carbon treatment. Dyeing wastewaters were successfully treated with alum and organic polymers, ozonation (acid and direct dyes), recovery of dyes without changing their chemical nature, electrochemical treatment of acid monoazo dyes, and landfilling of concentrated dyes with hypochlorination of dilute dye effluents. Techniques used for wool scouring effluents were a horizontal decanter centrifuge with addition of bittern flocculant or MgC12; a hot acid flocculation process; solvent extraction of wool wax from dewatered sludge; activated sludge process; a Humboldt Sl-1 decanter; a physical-chemical process consisting of chlorination, electrocoagulation/flotation in acid, neutralization and further flotation; and separation of waste streams to reduce the organic load to the biological treatment process. Several synthetic fiber plants initiated recycling of wastes treated by coagulation/filtration/adsorption/ozonation, activated carbon adsorption, or flotation. Ultrafiltration was effective in recovery of polymeric sizing agents. Zirconium oxide, cellulose acetate, and polyamide membranes were considered. Water reuse treatments for polymer size recovery included high-temperature ultrafiltration, hypofiltration, and coagulation with recovered salt solutions. Kapron

and nylon-548 production wastes were polymerized to form glue-type polymers with excellent adhesion properties. (Cassar-FRC)
W82-06916

FERMENTATION INDUSTRY,
Notre Dame Univ., IN., DepT. of Civil Engineering.
S. C. Chiesa, R. L. Irvine, and J. F. Manning, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 695-700, June, 1982. 70 Ref.

Descriptors: *Literature reviews, *Fermentation, *Industrial wastewater, *Wastewater treatment, *Reviews, Anaerobic digestion, Aerobic treatment, Biomass, Feeds, Methane, Drugs, Antibiotics, Fertilizers, Yeasts, Fuel.

Recent work on treatment of fermentation wastes was reviewed. In addition to reuse, recycling and recovery techniques such as production of ethanol, methane, biomass, animal feed, fertilizers, and building materials, other treatment alternatives were proposed. Brewery wastewaters were treated with activated sludge and biological filters, dilution with municipal wastewater, adsorption of heavy metal ions on immobilized tannin, the aeroaccelator system (high-rate biological treatment), bacterial methods, pure oxygen activated sludge, and anerobic processes. Common biological treatment methods were successful in treating yeast factory wastewaters; high temperature and metallic catalysts were tried by one investigator. Several investigators characterized distillery wastes. Treatment methods included incineration, composting, extended aerobic biological treatment, anaerobic treatment (contact process and two-phase system), and the Anamet anaerobic/aerobic process. Winery wastewaters were purified by electrochemical means or with yeast cells. Shock chlorine doses controlled excessive foaming and bulking in an activated sludge system. Pharmaceutical wastes were treated by a variety of methods depending on the nature of the pharmaceutical process: ammonium ions were removed by physical/chemical treatment with clinoptiolite; organic solvents, by Amberlite resins; antibiotics, by coagulation with ferrous sulfate and polyacrylamide and centrifugation or combustion; and tellurium oxide, by reduction with SnC12 and coprecipitation with ferric hydroxide. Several references dealt aerobic and/or anaerobic treatment of wastes. Removal efficiencies of 26 priority pollutants were compared for several treatments, the best of which was activated sludge with added activated carbon. (Cassar-FRC)
W82-06917

FRUIT, VEGETABLE, AND GRAIN PROCESSING WASTES,
Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL.
R. A. Morrell, and H. E. Schmidt, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 692-695, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Fruit crops, *Vegetable crops, *Industrial wastewater, *Reviews, *Wastewater treatment, Biological treatment, Activated sludge process, Anerobic digestion, Lagoons, Wastewater lagoons, Filtration, Water pollution prevention, Land disposal, Grain crops, Canneries.

Two books and an operations manual for biological treatment were among the new literature on food processing wastes. Several papers on treatment processes for a variety of food wastes included information on a lamella-type separator for removing suspended solids, a low-load activated sludge wastewater treatment plant for combined domestic and food wastes, and the application of land disposal techniques. Treatment systems designed for fruit wastes included a highly loaded two-stage stone media biofilter. Tomato waste treatments included a physical-chemical system with aeration and carbon filter bed, as well as spray irrigation, land application, and anaerobic digestion. For citrus wastes methane fermentation was discussed. The following processes and equipment were developed for handling wastewaters from vegetable processing: a rotating drum screen for liquid-solid separation and a blancher using steam that produces one-tenth the volume of effluent and one-fourth the BOD levels. For beet sugar wastewaters suggestions included Fe coagulation/flocculation, vacuum filtration, treatment in a municipal plant after pretreatment, and irrigation with effluent. For potato wastewater use of a horizontal anaerobic filter with 90% BOD removal, 2 anaerobic lagoons in parallel followed by anaerobic filter and aeration were considered. Controlled culture fermentation was successful in treatment of pickle, greens, olive, and bean processing liquids. An experimental washer for greens produced lower pollutant levels than an industrial washing system. Olive processing wastes were composted in a tank containing soil. Bean-blanching wastes were treated in anerobic fixed film reactors. (Cassar-FRC)
W82-06918

DAIRY WASTES,
Kraft, Inc., Glenview, IL.
J. C. Groenewold.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 700-702, June, 1982. 47 Ref.c

Descriptors: *Literature reviews, *Dairy industry, *Food-processing wastes, *Industrial wastewater, *Reviews, Wastewater treatment, Regulations, Economic aspects, Legislation, Biological treatment, Lagoons, Fermentation, Membrane processes, Land disposal, Wastewater disposal, Activated sludge process, Animal wastes, Bacteria.

A review of the past year's information on treatment of dairy wastes listed several general papers: the types of dairy wastewater treatment in Poland; literature reviews, including pollution from milk losses (considered trivial), and sampling and flow measuring techniques. Other general subjects included combined municipal-dairy effluent treatment and the unit processes of an ideal dairy waste treatment system. Among the papers on regulations, legislation, and economics, several favored land applicatiion. Whey disposal options included fermentation, land disposal by spraying, animal feed production, extraction of lactose and other useful components, and reverse osmosis followed by evaporation or ultrafiltration. Several case histories were described. The nutrient application in long-term land disposal should not exceed the nutrient amounts removed as forage. A biospiral system and drum filter tertiary treatment unit for creamery effluent reduced BOD to 3 mg per liter. Other treatment systems in actual use were anaerobic-aerobic lagoons, bacterial bed treatment using a variety of media, extended aeration, and physical-chemical treatment. Research efforts involved combined farm waste-milk waste lagooning, a rotating biological contactor, a multistage bubble separator, pretreatment and discharge into the municipal system, enzymatic prehydrolysis (unsuccessful), the effect of light wavelength on bacterial production of ethanol, characterization of various dairy wastes, and isolation of a new bacteria from dairy waste activated sludge. (Cassar-FRC)
W82-06921

ANAEROBIC PROCESSES,
Institute of Gas Technology, Chicago, IL.
K. F. Fannin, J. R. Conrad, V. J. Srivastava, D. E. Jerger, and D. P. Chynoweth.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 612-623, June, 1982. 1 Tab, 130 Ref.

Descriptors: *Literature reviews, *Anaerobic conditions, *Reviews, Agricultural wastes, Digestion, Anaerobic digestion, *Wastewater treatment, Municipal wastewater, Industrial wastes, Bacteria, Microbiological studies, Methanogenesis, Design criteria, Economic aspects.

Recent research in the area of anaerobic processes is cited in this literture review. Reviews published dealing with the entire subject included works on the status of work in the United States on biomass and waste-to-energy processes and various digester types used in European farm anaerobic digestion before 1970. In the area of microbiology papers dealing with classification and characterization included efforts made toward the isolation of a filamentous, facultative anaerobic microorganism which attached lignified tissue in forage grasses, on the diversity of microorganisms involved in cellulose fermentation, and on the electrical potential and intracellular pH of two methanogenic bacteria. Microbiology papers also dealt with cellulose hydrolysis, acidogenesis, and methanogenesis. Process stability was considered in studies dealing with acid and alkaline phosphatase activity used as biochemical predictors of digestor failure. Process optimization research dealt with general methodology, attached-film reactors, sludge bed reactors, two-phase reactors, stirred-tank reactors, peat and landfill digestion, and ethanol fermentation. Energy and economic assessment was also considered. Process application research centered on municipal wastewater studies, municipal solid wastes, process wastes, and agricultural wastes. Patents which were obtained are briefly noted. (Baker-FRC)
W82-06923

MICROBIOLOGY: WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA., Dept. of Biological Sciences.
W. O. Pipes, and H. A. Minnigh.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 987-989, June, 1982. 45 Ref.

Descriptors: *Literature reviews, *Wastewater treatment, *Reviews, Activated sludge process, Sludge, Sludge disposal, Land disposal, Industrial wastes, Bacteria, Stabilization ponds, Anaerobic condition, *Microbiological studies, Nutrients, Phosphorus removal.

Recent research in the field of wastewater treatment is cited in this literature review. Microbiological oxidation of reduced nitrogen compounds in aerobic wastewater treatment processes and particularly the conditions that lead to inhibition of such oxidation were topics of research in 1981. Interactions among microorganisms in anaerobic sludge digestion were also reported. Activated sludge research centered on the isolation of floc-forming bacteria from activated sludge on casitone-glycerol-yeast extract agar, on a laboratory model flocculation system based on pure cultures of Escherichia coli, on cell residence time and its influence on microbial composition of activated sludge produced in a completely mixed laboratory system of treated domestic wastewater fortified with sugars and organic acids, on hydrazine inhibition of Nitrobacter and Nitrosomonas in activated sludge, on absorption of uranium and thorium by activated sludge, and on the occurrence of cysts of Entamoeba histolytica and Giaridia lamblia and the ova of Ascaris, Trichuris, and Hymenolopsis in wastewater and effluents from activated sludge systems in India. Stabilization ponds were studied concerning their effectiveness in wastewater treatment for nitrogen and phosphorus removal and for reduction of virus content. Land disposal was examined with regard to Salmonella havana persistence. Sludge treatment processes were investigated using staged anaerobic digestion, and included work on the formation of diethyl amine from creatinine in digesting wastewater sludge and on the survival of microorganisms after anaerobic digestion and prolonged periods of lagooning. Industrial wastes were also considered. (Baker-FRC)
W82-06926

PRELIMINARY STUDIES ON THE DEWATERING OF COAL-CLAY WASTE SLURRIES USING A FLOCCULANT,
Bureau of Mines, Tuscaloosa, AL. Tuscaloosa Research Center.
J. R. Zatko, B. J. Scheiner, and A. G. Smelley.
Report of Investigations RI 8636, 1982. 18 p, 7 Fig, 9 Tab, 6 Ref.

Descriptors: *Mine wastes, *Dewatering, *Slurries, *Flocculation, Coal mining, Clays, Water reuse, *Wastewater treatment, Polyethylene oxide.

In the preparaton of coal to produce low-ash material, a waste product containing fine coal and clay is generated. This waste product, generally minus 28 mesh in size with the major portion being minus 325 mesh, is difficult to handle due to the slow settling of the fine-sized clay particles. In laboratory-scale and small-scale continuous tests, coal-clay waste slurries from two commercial preparation plants were dewatered using polyethylene oxide (PEO) as a flocculant. Slurries containing up to 50-wt-pct solids using 0.5 lb of PEO per ton of feed solids in small-scale continuous tests. The tests also indicated that a pH of at least 9 was required for West Virginia slurry, while a pH of 7 for the Alabama slurry was adequate. Initial solids content had little effect on dewatering. Water recovered from dewatering was used as dilution water for 0.25-wt-pct PEO solutions without any deleterious effect. (Moore-SRC)
W82-06958

ELECTROKINETIC DENSIFICATION OF SOLIDS IN A COAL MINE SEDIMENT POND-A FEASIBILILTY STUDY, (IN TWO PARTS), 1. LABORATORY AND FIELD TESTS,
Bureau of Mines, Spokane, WA. Spokane Research Center.
R. H. Sprute, and D. J. Kelsh.
Report of Investigations RI 8666, 1982, 36 p, 15 Fig, 8 Tab, 5 Ref.

Descriptors: *Electrophoresis, *Electro-osmosis, *Mine waste, *Dewatering, *Sludge, Water reuse, Strip mine wastes, Underflow, Densification, *Washington, *Wastewater treatment.

The Washington Irrigation and Development Company (WIDCO) operates a large, multiseamed surface mine in western Washington to supply coal for a steam-electric generating plant. The mine's preparation plant thickener typically discharges about 2,600 gpm of underflow. Disposal is unusually difficult because of the large volume, suspended particles that are extremely resistant to natural settlement, and physical properties that ghange significantly and unpredictably as mining progresses. The watery underflow is pumped into a large pond where solids settle slowly and surface water is decanted for reuse in the plant. Since startup in 1970, the pond has grown to 100 acres or more with a center depth of 110 ft. Laboratory and field test results show that coal waste sludge in the WIDCO impoundment can be effectively consolidated by applying direct current between floating and buried electrodes. Treatment develops clear surface water for decanting, while 75 to 80% of the residue gradually densifies into a firm claylike product. The process becomes economically feasible when power is applied with low current density (5 to 6 ma/sq ft) and a potential of 25 v or less. Test results projected in an operational system for the WIDCO pond include a 21-acre surface electrode, submerged iron anodes, and a 12,000-amp dc power supply. Treatment would be continuously applied for 2 to 3 years. (Moore-SRC)
W82-06960

DECONTAMINATION OF OVERLAND RUNOFF FROM POPULATED AREAS,
Ministry of Reclamation and Water Management, Moscow (USSR).
Y. P. Belichencko.
Water Resources, Vol 8, No 4, p 415-149, July/August, 1981. 11 Ref. Translated from Vodnye Resursy, No 4, p 126-131, July/August, 1981.

Descriptors: *Storm wastewater, *Urban runoff, *Combined sewers, Storm sewers, Storm runoff, Storm water, Overland flow, Sewer systems, Water quality, Snowmelt, Runoff, Rainfall-runoff relationships, Water treatment, *Wastewater treatment, *USSR.

Storm water runoff from urban areas contains a variety of organic and inorganic pollutants: BOD, 12.5-145 mg per liter; suspended solids, 450-5000 mg per liter; petroleum products; asphalt, 50 g per 1 sq m paving; tire material; rubbish; leaves; and dust. Pollutant concentrations are highest at the beginning of a rain storm and at the start of the warm period in April. Snowmelt water generally has higher pollutant levels and greater variation in quality than rain water. Factors controlling the pollution levels in storm water runoff are type and condition of paving, street cleaning regime, traffic intensity, population density, and industrial activity. Treatment systems presently available are: combined sewers, separate sewer systems (industrial-domestic wastewaters delivered to treatment plants and storm water delivered untreated to the nearest surface water), and semiseparate sewers. In the semiseparate sewers all industrial-domestic wastewaters are delivered for treatment. Only the more polluted storm waters are routed to the treatment plant. This includes street washing water, rainfall from low-intensity storms, and melt waters. The nearly unpolluted runoff from heavy rainfall may be discharged into surface waters without treatment. Storage of storm waters in ponds or tanks for later treatment is advantageous because it evens the load on the treatment plant. (Cassar-FRC)
W82-06980

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,
Scientific Research Inst. of Plastics, (USSR).
N. E. Kozhevnikova, and K. M. Saldadze.
Water Resources, Vol 8, No 4, p 436-443, July/August, 1981. 4 Tab, 36 Ref. Translated from Vodnye Resursy, No 4, p 153-160, July/August, 1981.

Descriptors: *Desalination, *Membrane processes, *Reverse osmosis, *Ultrafiltration, *USSR, Industrial wastewater, Brackish water, *Wastewater treatment, Water treatment, Reviews, Electrodialysis, Separation techniques, Demineralization, Saline water, Seawater.

Membrane methods (electrodialysis, reverse osmosis, and ultrafiltration) for wastewater treatment, desalination, and water treatment are reviewed. These processes have been used widely in the U.S. since 1967. In the USSR pilot plants are being set up for cellulose acetate reverse osmosis and ultrafiltration. Single stage plants can be used for mildly saline waters, but multistage plants are necessary for highly concentrated solutions and seawater. The problem of disposing of the concentrated wastes produced by inland desalting plants can be handled by recovering waste materials for resale. An economic analysis shows that water with < 2 g per liter salt is processed more economically by ion exchange; 3-8 g per liter by reverse osmosis; and > 20 g per liter by reverse osmosis and distillation. Tables list data for five U.S. plants desalting water by the reverse osmosis method and possibilities for extracting byproducts from industrial wastewaters by membrane processes. Several examples of treating chemical and industrial wastewaters are discussed. (Cassar-FRC)
W82-06988

PROSPECTS OF USING MAGNETIC WASTEWATER TREATMENT,
Gosudarstvennyi Nauchno-Issledovatelskii Inst. Gornokhimicheskogo Syrya, Lyubertsii (USSR).
V. I. Klassen.
Water Resources, Vol 8, No 4, p 431-436, July/August, 1981. 1 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No 4, p 146-151, July/August, 1981.

Descriptors: *Magnetic wastewater treatment, *Water properties, *Wastewater treatment, *USSR, Industrial wastewater, Municipal wastewater, Chemical wastewater, Reviews, Activated sludge process, Biological treatment, Parasites, Light extinction, Suspended solids, Coagulation, Organic compounds.

Developments in magnetic wastewater treatment in the Soviet Union are reviewed. This technique is currently in use for controlling boiler scale and treating industrial and natural waters. Important factors to consider are magnetic field strength, its gradient, its frequency, velocity of the water, and pressure drop in the interpolar space. Subjecting water containing impurities to magnetic treatment changes many of its properties temporarily, for hours or days. Among the changes are an increase of light extinction, a decrease in the stability of diamagnetic ions such as Mg and Ca, changes in infrared spectra, and a 2-4-fold increase in cohesive forces on particles in a suspension. The apparatus for magnetic wastewater treatment consists of several pairs of magnets, either permanent or electromagnetic, between the poles of which the water flows at a velocity of 1-2 m per sec. Those being manufactured at present have a maximum capacity of 25 cu m per hour. Magnetic treatment has produced good results when used alone or in combination with other treatment techniques. Examples of these applications are treatment of wastewater containing suspended solids, organochlorine manufacturing wastewater, industrial wastewater containing nonferrous metals such as Zn, iron-containing acid solutions, copper ore flotation recycling water, livestock wastewater, and municipal wastewater., In chemical and industrial wastewater, magnetic treatment enhances the removal of organic impurities by the activated sludge process. 100% of helminth eggs were killed during a magnetic treatment of a pig farm wastewater with a field strength of 300-500 Oe and frequency of 8-16 Hz with the addition of 50 mg per liter ferromagnetic powder. (Cassar-FRC)
W82-06989

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,
Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 5G.
W82-06992

THE ELECTROLYTIC PROCESS FOR CHROMATE REMOVAL IN COOLING TOWERS,
First Chemical Corp., Pascagoula, MS.
T. T. Taylor.
Chemical Engineering Progress, Vol 78, No 6, p 70-72, June, 1982. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Cooling water, *Wastewater treatment, *Separation techniques, *Chromium, *Electrolysis, Industrial water, Water cooling, Cooling towers, Heavy metals, Electrodes, Corrosion control, Drinking water, Standards.

Since blowdown water from cooling towers contains all the constituents that are in the cooling tower water itself, it must be processed before discharge so that it meets environmental standards. Chromate, a corrosion inhibitor in cooling water, is limited to a maximum level of 0.05 ppm as hexavalent chromium in drinking water. To remove chromate from cooling tower blowdown, an efficient electrolytic metal removal process is recommended. This electrochemical process consists of sacrificial iron electrodes that have direct current applied to the anodes and cathodes to produce ferrous hydroxide. Chromate is then reduced from the hexavalent state to the insoluble trivalent form by the ferrous hydroxides. The electrolytic method has consistently removed chromate to less than 0.05 ppm chromium at an estimated operating cost of $0.13/cu m of cooling tower blowdown treated. (Geiger-FRC)
W82-06996

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,
Battelle Columbus Lab., OH.
J. H. Litchfield.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 688-692, June, 1982. 1 Tab, 65 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Meat-processing industry, *Wastewater treatment, *Industrial wastewater, Poultry, Fish, Activated sludge process, Biological treatment, Aminodan process. Ultrafiltration, Flotation, Coagulation, Reviews, Anaerobic digestion, Biodegradation, Aerobic conditions.

Recent developments in handling meat-, fish-, and poultry-processing wastes were discussed in reviews and in individual papers. Fats and proteins

were the major contributors to COD. Some treatment techniques for meat-processing wastes included physicochemical processes, anaerobic filtration, activated sludge with mechanical aeration, coagulation with ferric sulfate-magnesium chloride-aluminum sulfate, cellulose activated with inorganic salts, lignite treated with sulfuric acid, a modular waste treatment plant featuring flocculation with anionic and cationic polymers and filtration through fiberglass cartridges, activated carbon adsorption, membrane processes, lagoons, flotation, electrocoagulation, sulfide liquor as a coagulant, calcium carbonate or calcium peroxide, anaerobic systems, the Aminodan process, sedimentation, heating followed by centrifugation, ultrafiltration, and combinations of the preceeding. Fish and seafood wastes were treated with fish scale coagulant, ultrafiltration, an anaerobic-aerobic shipboard system, electroflotation/electrocoagulation, coagulation, pressure flotation and separation of protein at the isoelectric point, aeration with a rotating disk, activated sludge process, activated sludge-activated carbon, and dissolved air flotation. Plant and pilot scale studies of poultry- and egg-processing wastewater treatment were summarized in a table. All of the following treatment processes were 90% effective in removing BOD, COD, suspended solids, ammonia, and phosphate: dissolved air flotation with counter-current aeration; activated sludge with 6-hour detection time; equalization dissolved air flotation with draft tube oxidation channel, clarifiers, facultative and polishing lagoons, and chlorination; and aerobic reaction for 8 days plus anaerobic digestion for 18 days. Other techniques included lime-polymer conditioning and solvent extraction. (Cassar-FRC)
W82-07000

5E. Ultimate Disposal Of Wastes

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-05904

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
For primary bibliographic entry see Field 5B.
W82-05946

SLUDGE MANAGEMENT: A RESEARCH UPDATE,
Duke Univ., Durham, NC.
P. A. Vesilind.
BioCycle, Vol 23, No 2, p 39-41, March/April, 1982. 28 Ref.

Descriptors: *Sludge digestion, *Sludge disposal, Wastewater treatment, Sludge filters, Sludge thickening, Pathogens, Composting, Dewatering, Reviews, Mixing.

Sludge management was the subject of reports, booklets, and about 20 journal articles during 1981. A mathematical model for regional management of sludge handling facilitates evaluation of alternate treatment and disposal options. Studies on head losses in sludg pipelines led to conclusions that the pipelines should be designed for turbulent flow and a safety factor of 50%. A procedure for calculating the movement of sludge by rakes was developed. A survey of thickening practices in Great Britain produced some conclusions helpful in designing thickeners. In the field of dewatering, belt filters and centrifuges were compared in 3 full-scale studies with mixed results. Low speed dewatering centrifuges performed as well as high-speed machines and used less power. Plugging of filter fabrics followed a first-order relationship. Two methods of determining the maturity of compost were phytotoxicity to bean seeds and rate of oxygen use. Indicator viruses were used to study the fate of viruses in wastewater treatment. Some areas ripe for more research are sludge decomposition nd mixing in anaerobic digesters. (Cassar-FRC)
W82-06007

LAND TREATMENT OF INDUSTRIAL WASTES: PRINCIPLES AND PRACTICES. PART II,
Science and Education Administration, Beltsville, MD.
G. B. Willson, J. F. Parr, J. M. Taylor, and L. J. Sikora.
BioCycle, Vol 23, No 2, p 59-61, March/April, 1982. 1 Fig, 7 Ref.

Descriptors: *Land application, *Chemical wastes, *Composting, Waste disposal, Degradation, Sludge disposal, Aeration.

Land application of chemical wastes is a viable treatment alternative if the physical, chemical, and biological limits of the soil are respected. Composting of industrial wastes or composting with sewage sludges may minimize toxicity to soil microflora and damage to the environment when the wastes are applied to the soil. Another approach to land treatment is preconditioning a site with sewage sludge prior to direct application of chemical wastes. Several insecticides, but not DDT, degraded rapidly when composted with cannery wastes. Composting petroleum refinery sludges reduced grease and oil significantly. Guidelines for preventing contamination of surface and groundwaters at land treatment sites were suggested in the May 19, 1980, Federal Register. Runoff and soil erosion should be minimized, and groundwater quality should be monitored before, during and after application. (Cassar-FRC)
W82-06009

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W82-06038

A COST-EFFECTIVE SYSTEM FOR THE AEROBIC STABILIZATION AND DISPOSAL OF WASTE ACTIVATED SLUDGE SOLIDS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 5, p 535-542, May, 1982. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Sludge disposal, *Construction costs, *Aerobic treatment, Sludge lagoons, Sludge solids, Lagoons, Stabilization lagoons, Design criteria, Land disposal, *Activated sludge, Kinetics, Costs, Sludge thickening.

Construction costs, power usage, and operating features of five types of aerobic stabilization systems were compared. Using the continuous post-thickening system as 1.00, the pre-thickening single cell system had a ratio of 0.99; pre-thickenig with five-cell system with or without variable retention time, 0.78; and semi-batch system, 1.90 for the pre-thickening single cell system, and 0.72 for the pre-thickening five-cell system with variable retention time. Kinetic data for the aerobic stabilization of waste activated sludge solids were reviewed and evaluated. Guidelines are given for the design and operation of three systems: a multicellular aerobic stabilizer, a 12 months stabilized solids storage lagoon, and a dedicated land disposal activity. (Cassar-FRC)
W82-06046

SLUDGE TANKERING ECONOMICS - A FRESH APPROACH,
Severn Trent Water Authority, Birmingham (England).
C. E. Brade, and J. M. Harwood.
Effluent and Water Treatment Journal, Vol 22, No 3, p 111, 114, 115-121, March, 1982. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Sludge disposal, *Solid waste disposal, *Economic aspects, Sludge thickening, Waste disposal, Waste load, Land disposal, Costs, Cost analysis, Sludge solids, Sludge utilization, England.

In 1975, 68% of all sludge in the United Kingdom was disposed to land. When hauling sludge by tankers, 2,000 gallon tankers are more economical for short hauls (less than 10 miles round trip) than larger tankers. The 3,000 gallon tanker is more economical for longer hauls. The 3,000 gallon take offers better off-the-road performance than the 2,000 gallon tanker and is less sensitive ot increases in labor costs. It is best to operate the tanker fleet for the longest possible working day, even if overtime wages must be paid. Fuel is a small factor in the overall cost of tankering sludge on the round-trip journeys common to water authority work. Money may be saved by reducing the load, fill and empty cycle time and increasing sludge thickness as much as possible. (Geiger-FRC)
W82-06076

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Washington, DC.
For primary bibliographic entry see Field 6G.
W82-06087

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,
Riyadh University (Saudi Arabia). Coll. of Agriculture.
M. El-Nennah, T. El-Kobbia, A. Shehata, and I. El-Gamal.
Plant and Soil, Vol 65, No 2, p 289-292, 1982. 4 Tab, 17 Ref.

Descriptors: *Irrigation, *Wastewater disposal, Heavy metals, Chemical composition, Soil-water-plant relationships, Public health, Cairo, *Egypt, Contamination.

This paper investigates the levels of specific nutrients and heavy metals in soils as influenced by sewage effluent deposition for various lengths of time. Surface and subsoil samples were taken from areas cultivated with citrus trees. Four of the sampling sites were from two farms irrigated with sewage effluents for 23 and 47 years. The control area samples were irrigated with artesian water. Using sewage effluents in irrigation year after year was shown to increase the available phosphorus and both total and soluble nitrogen in the soil. Surface layers generally contained higher amounts of elements than the subsurface ones. The same results were noted for water soluble boron and total and extractable heavy metals. Cairo sewage effluents were seen to contain higher accumulations of soluble salts, boron, and heavy metals than the tap water in the city, due to pollution of wastewater with industrial wastes and household laundry chemicals. It is concluded that the use of Cairo sewage effluents for crop irrigation has increased the levels of water soluble boron and heavy metals in the loamy sand soil. The increase of heavy metals and their subsequent uptake by plants should be considered a potential problem. (Baker-FRC)
W82-06228

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,
Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.

For primary bibliographic entry see Field 5B.
W82-06232

DISCHARGE TO THE NORTH SEA,
Tayside Regional Council (England).
A. Cockburn.
Water/Engineering and Management, Vol 129, No 5, p 30-32, May, 1982.

Descriptors: *Outfall sewers, *Wastewater disposal, Wastewater outfall, Outfall, *North Sea, Wastewater dilution, Wastewater treatment, Wastewater management, Municipal wastewater, *Scotland, Arbroath, Industrial wastes, Construction, Pipelines.

Arbroath, with a population of 21,000, lies on the North Sea coast of Scotland, 10 miles from the estuarine mouth of the River Tay. Arbroath is an important engineering center with other industries as well, including textiles, fishing, fish-processing and leisure industries. Wastewater treatment problems in the last decade have caused a ban on new building. Hydrographic and geophysical survey work was begun in 1976 with a view to building a long sea outfall. It was recommended that an overall length of about 3,100 feet would be needed, extending some 650 foot section of diffusers. An ultimate discharge flow of just under 350 gal/sec was decided upon. Protective treatment to the pipe was important due to the effects of heavy seas, tidal movements and the corrosive nature of sea water. Internal corrosion protection was achieved through a factory-applied isocyanate-cured coal tar epoxy resin with a minimum dry film thickness of 500 micrometers. External protection was accomplished with a quarter-inch thick bitumen enamel wrap, incorporating glass fiber fabric. This long sea outfall contract is the penultimate phase of the project which will bring about satisfactory sea disposal of much of Arbroath's sewage. Final phase of the project is construction of a pumping station and pretreatment facilities for screening and grit removal prior to discharge by the sea outfall. (Baker-FRC)
W82-06248

DISPOSAL OF SEWAGE SLUDGE TO SEA--ENGINEERING ASPECTS,
Strathclyde Regional Council, Glasgow (Scotland).
W. T. Greer.
Water Science and Technology, Vol 14, No 3, p 9-15, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Ships, Ozonation, Odor control, Activated carbon, Scotland, North Sea, Firth of Clyde.

In Scotland sewage sludge ocean dumping sites have been selected for economic, political, and environmental reasons rather than engineering considerations. Since 1974 all disposal sites must be approved by appropriate governmental departments. Shore facilities specific to sludge dumping include elevated sludge storage tanks for loading within a 1.5 hour period, sufficient pumping capacity, and loading pipes which adjust to the changes in level as the ship rises and falls with filling and the tides. Odor has been controlled by scrubbing foul air with ozone enriched water or treating with activated carbon. Sludge ships are modified tanker ships. The sludge load can be discharged by gravity within 15 min by incorporating large buoyancy spaces beneath the sludge tanks, placing the level of the top of the sludge above sea lovel. Newer ships discharge sludge by air pressure. As the lighter-than-water sludge enters the sea, it is dispersed by the ship's propellers to a 200-400 fold dilution, leaving a slick which is quickly broken up by wave action. (Cassar-FRC)
W82-06286

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W82-06287

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5B.
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,
Camp, Dresser and McKee Inc., Boston, MA.
J. A. French.
Water Science and Technology, Vol 14, No 3, p 25-31, 1982. 5 Fig, 4 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Sedimentation, Turbulent flow, Suspended sediments, Advection, Particulate matter, Settling velocity.

The particles from sewage sludge dumped into the ocean move downward and laterally, depending on particle density and ocean currents. Classical stream sedimentation analysis is used to describe three types of particle settling: unaffected by turbulence, influenced by turbulence, and dominated by turbulence. Equations are given for predicting the particles' trajectories, which are curved. (Cassar-FRC)
W82-06289

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,
Coastal Water Research Project, Long Beach, CA.
For primary bibliographic entry see Field 5C.
W82-06290

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,
Thames Water Authority, London (England).
A. G. Cockburn.
Water Science and Technology, Vol 14, No 3, p 17-24, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Water quality standards, Regulations, Legislation, Monitoring, Water quality control, International agreements, Industrial wastewater, United Kingdom.

Technical control of sludge disposal at sea is carried out to protect the environment from toxic substances and excessive concentrations of organic matter. Control is exercised by legislation and international agreements. In England control is carried out by the disposer (a regional water authority), the licensing authority (Ministry of Agriculture, Fisheries and Food), and industry. The sludge must meet quality and quantity standards. If not, appropriate treatment or process changes are required. At all stages scientific methods are used to monitor sludge composition, water quality, and environmental changes. (Cassar-FRC)
W82-06291

SLUDGE DISPOSAL TO SEA IN U.K.,
Thames Water Authority, London (England).
L. H. Thompson.
Water Science and Technology, Vol 14, No 3, p 79-91, 1982. 2 Fig, 5 Tab, 10 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *United Kingdom, Thames Estuary, Ships.

Sludge disposal in the sea in the United Kingdom is summarized. Currently 12 water authorities (31 sewage works) dispose of sludge by dumping or pipeline. The three largest activities--London, Manchester, and Glasgow--have been operating for 80 or more years. A map depicts the origin of the sludge and the dumping grounds as well as populations and amounts of sludge produced. The Thames Estuary dumping operation is described in detail, and ten other operations are summarized. Ocean dumping of sludge has increased in the United Kingdom during the last two decades, contrary to the trends in the U.S. and Europe. The United Kingdom's strategy for the future is to incinerate heavily industrialized and special sludges, digest sludges, store and thicken sludges prior to land or sea disposal, ensure that sludge quality is suitable for disposal, choose sludge disposal sites according to economics with preference to land application in marginal cases, and consider each case individually. (Cassar-FRC)
W82-06292

DISPOSAL OF SEWAGE SLUDGE TO SEA--RESEARCH NEEDS,
Water Research Center, Stevenage (England).
A. R. Agg.
Water Science and Technology, Vol 14, No 3, p 71-77, 1982. 1 Tab, 12 Ref.

Descriptors: *Research priorities, *Ocean dumping, *Sludge disposal, Fate of pollutants, Nutrients, Particulate matter, Water pollution effects, Degradation, Organic compounds, Algae, Heavy metals, Sedimentation.

The need for further research on the environmental effects of ocean dumping of sewage sludge is discussed with reference to the United Kingdom. Major effort should be directed toward determining the assimilative capacity at selected sites and the effects of improving sludge quality on the quantity of sludge which can be disposed of. Special topics for which further information is needed are: (1) determination of relative inputs of potential contamination from all land-based sources, (2) physical processes controlling dispersion, sedimentation, and degradation of sludge solids, (3) mechanisms which control mobilization and transfer of metals and organic chemicals from sludge, and (4) the role of nutrients and other sludge components in development of certain algal blooms. (Cassar-FRC)
W82-06293

SELECTION OF A SLUDGE HANDLING DISPOSAL SYSTEM,
Malcolm Pirnie, Inc., Paramus, NJ.
A. F. Hess, and M. J. Barnes.
In: Water/Engineering and Management, Reference Handbook-1982, p 61-64, 66-67, May, 1982. 2 Fig, 40 Ref.

Descriptors: *Sludge disposal, *Design criteria, Wastewater treatment, Water treatment facilities, Coagulants, Filtration, Sludge dewatering, Lagoons.

The problem and expense of ultimate disposal of water treatment plant sludge are discussed. Estimating the quantity of solids produced at a water treatment plant is the first step involved in the selection and sizing of a sludge handling and disposal facility. The solids load is a function of the raw water suspended solids and color, the dosage and type of chemicals used in the treatment process and the quantity of water treated at the plant. Waste volumes are dependent on the solids loads and the estimated solids concentration of the sludge. The quantity and characteristics of sludge produced during water treatment is affected significantly by the design and performance of the treatment processes, especially rapid and slow mixing, points of chemical addition and short circuiting. The principal methods for reducing sludge quantities are source control, coagulant conservation, coagulant substitution, coagulant aids, process optimization, process modifications, coagulant recovery, and direct filtration. Various dewatering systems have been tested on all types of water treatment plant sludges. Feasible alternatives for dewatering sludge include: sand drying beds, lagoon, vacuum filtration, pressure filtration, centrifugation, belt filtration, and recalcination. Ultimate disposal of sludge from a water treatment plant is primarily dependent on the characteristics of the processed and dewatered sludge, especially the water content of the sludge cake. Based on the characteristics of dewatered sludge potential methods include contract or joint disposal, landfilling, use as cover material at landfill or strip mine, use as a soil conditioner, and conversion to a usable or salable product. (Baker-FRC)
W82-06346

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W82-06347

A LOOK AT CO-DISPOSAL,
Temple Univ., Philadelphia, PA. Coll. of Engineering Technology.
B. P. Butz, and L. B. Calhoun.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EY2, p 79-90, June, 1982. 11 Ref.

Descriptors: *Waste disposal, *Incineration, *Sludge disposal, Sludge, Solid wastes, Wastewater treatment, Municipal wastes, *Co-disposal, Recycling, Energy conservation, Financing, Performance evaluation.

One alternative that a municipality might consider for the disposal of solid waste and sludge is combined disposal, or co-disposal. Resource and energy recovery systems are often incorporated in co-disposal designs, which are considered innovative in the United States. Thermal co-disposal in either solid waste or sludge burning equipment has been shown to be feasible technologically. Co-incineration in solid waste burning incinerators is the best developed and proven co-disposal technology. Pyrolysis is a high risk technology. These plants are generally complex, expensive, and subject to breakdowns. The benefits of resource recovery techniques seem to be overvalued. The poor track record of co-disposal plants presents potential investors with a theoretically promising technology, but one that has high risk. Unless this risk can be minimized, co-disposal projects will have a difficult time securing financing. The environmental impact of a particular co-disposal plant will depend on the particular process selected and the characteristics of the geographical area in which the plant will be located. Insufficient data exist to quantify the adverse environmental impacts. Some impacts, such as those on water quality, should be no greater than for separate incineration of sludge and solid waste. (Baker-FRC)
W82-06354

LAND DISPOSAL OF SEWAGE SLUDGE, A SUMMARY OF RESEARCH RESULTS, 1972-1980,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
Y. K. Soon, and T. E. Bates.
Ontario Ministry of the Environment, Toronto, Report, 1981. 167 p, 15 Fig, 103 Tab, 26 Ref.

Descriptors: *Land disposal, *Wastewater, *Sludge disposal, *Application rates, *Wastewater farming, Wastewater treatment, Wastewater disposal, Soil disposal fields, Broad irrigation, Phosphorus removal, Chemical treatment, Digested sludge, Fertilizers, Greenhouses, Crop yield, Crop production, Soil organic matter, Coliforms.

Land application of fluid sewage sludge from chemical treatment for phosphorus removal was studied to determine safe rates of sludge application to agricultural soils without polluting ground/surface waters with elements/bacteria harmful to humans/animals or without reducing the quantity/quality of the crops produced. The various study phases involved: runoff assessment with fall/winter/spring-applied sewage sludge; rate and source of sludge field studies with corn and bromegrass; nitrogen studies; microbial studies; pedological study and characterization of sludge-treated soils; a greenhouse study on metal uptake with sludges; and a greenhouse and laboratory study to select a chemical extractant for plant-available heavy metals in polluted soils. Runoff losses of nutrients/metals can be acceptable provided the sludges are applied at less than 1.5 cm/application, are applied at least 48 hours before predicted heavy rains, and are not applied to steep slopes, near waterways, or to ice/snow/frozen soils. Low sludge rate applications produced corn/bromegrass yields as high as ammonium nitrate plus phosphate fertilizers. While fluid-digested sludges contained co nsiderable total and fecal coliforms and streptococci, its application to crop land did not result in a greatly-increased level of these microorganisms in runoff waters. Multiple regression analysis of 9 extractants tested showed diethylenetriamine pentaacetic acid as the most suitable for cadmium, nickel, and zinc. (Zielinski-MAXIMA)
W82-06377

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,
Argonne National Lab., IL.
S. W. Ballou, L. Dale, R. Johnson, W. Chambers, and H. Mittelhauser.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0107, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV-0107, September 1980. 44 p, 5 Fig, 30 Tab, 21 Ref.

Descriptors: *Feedlot wastes, *Sludge, *Anaerobic digestion, *Manure, *Energy conversion, *Incineration, Cost analysis, Biological treatment, Fuel, Treatment facilities, Pyrolysis, Water pollution, Air pollution, Environmental effects.

Literature on waste processing and energy conversion, and interviews with manufacturers was used for baseline data for construction of theoretical models using three energy conversion processes: anaerobic digestion, incineration, and pyrolysis. Anaerobic digestion of municipal sludge can be used to recover energy from sludge while simultaneously destroying pathogenic organisms and odors associated with the sludge. Digester gas can be used as fuel at the wastewater treatment plant that produces the sludge feed to the digester. Anaerobic digestion of manure yields gas with a heating value of 600 Btu/cu ft. Digested manure is considered a good source of animal feed, in addition to its utility as fertilizer. Recovery of energy by sludge incineration involves raising steam by cooling the hot flue gases. The steam may be used for heating but the most attractive possibility is to use steam turbines to drive motors directly or to produce electricity for the same use, in an associated wastewater treatment plant. Pyrolysis is a potentially efficient method for recovering energy from sewage sludge: the products can provide a significant portion of the energy required by municipal wastewater treatment plants. For manure, energy production by pyrolysis is assumed to occur near markets for the recovered energy. Although the systems would provide benefits in terms of waste disposal as well as energy production, they would also involve additional pollution of air and water. (Moore-SRC)
W82-06405

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,
Camden County Municipal Utilities Authority, NJ.
For primary bibliographic entry see Field 5D.
W82-06461

RECOVERY OF ZINC FROM WASTEWATER TREATMENT SLUDGE,
Bureau of Mines, Rolla, MO. Rolla Research Center.
J. B. Stephenson, E. R. Cole, and D. L. Paulson.
Resources and Conservation, Vol 6, No 3/4, p 203-210, 1981. 6 Tab, 5 Ref.

Descriptors: *Zinc, *Metal-finishing wastes, *Sludge treatment, *Wastewater treatment, Industrial wastes, Electroplating.

Zinc was recovered from metal finishing wastewater treatment sludge by a process using roasting, leaching-purification, and electrowinning. The sludge, containing metal hydroxides, oil, organics, and water, was roasted at 600-800 C to avoid excessive Zn volatilization. The roasted filter cake contained 31.1% Zn, 2.9% Pb, 1.5% Sn, and 1% or less of Cu, Fe, C, and Ni. Leaching with dilute sulfuric acid for 2 hours at 348 K at a solids concentration of 300 g per liter produced a liquor containing (in g per liter); Zn, 154; Cu, 3.0; Ni, 0.6; and Fe, 0.2; with a pH of 1.9. About 90% of the Zn was extracted. The high concentration of Ni and other interfering impurities required modification of the standard purification process. Iron was removed with potassium permanganate. Zn dust purification did not reduce the Ni lvel to the desired 0.1 ppm. A second Zn dust treatment produced a filtrate satisfactory for electrowinning. The electrolyte was mixed with water and sulfuric acid. Lead dioxide-coated Ti anodes were used with 1100 alloy Al cathodes to electrowin the Zn at 560 A per sq m and 308 K. Deposit morphology was fairly good, but current efficiency was about 76%. (Cassar-FRC)
W82-06485

POTATO AND CORN BY-PRODUCTS USED AS CATTLE FEED,
Frito-Lay, Inc., Dallas, TX.
J. L. Revel.
Industrial Wastes, Vol 28, No 3, p 27-31, May/June, 1982. 3 Tab.

Descriptors: *Sludge disposal, *Food-processing wastes, *Waste recovery, *Feeds, Food processing industry, Industrial wastes, Cattle, Waste management, Recycling, Solid waste disposal, Land disposal, Cost analysis.

Frito-Lay, a division of PepsiCo Incorporated, has maintained primary and secondary wastewater treatment facilities for its potato and corn snack manufacturing plants for several years. The company faced sludge disposal problems and began to examine wet sale markets for by-products, sludge-by-product mixtures, and secondary treatment biosolids. Wet sale of potato and corn wastes can be profitable if shipping costs to buyers, mainly cattle raisers, can be kept down. Frito-Lay currently operates three plants with an installed potato starch recovery module. Secondary biosolids are being disposed of mainly via land application and municipal digesters. Frito-Lay is studying the feasibility of using biosolids as an animal feed ingredient. Procedures for registering animal feed by-products are explained. Efforts must be made to prevent contamination of by-products with substances which may be injurious to animal health. Hauling of commodities is regulated by various state and federal agencies and should include a contract for services to establish legal responsibilities. A back-up system for disposal is recommended. Frito-Lay has planned feed trials with dairy and beef cattle to increase acceptance of this cost-effective disposal method. (Geiger-FRC)
W82-06488

FEED FROM SEWAGE: PROSPECTS AND CONSTRAINTS,
New Mexico State Univ., Las Cruces. Dept. of Animal, Range and Wildlife Sciences.
G. S. Smith.
Biocycle, Vol 23, No 3, p 34-36, May/June, 1982. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Waste disposal, *Feeds, *Sewage, *Livestock, Cattle, Sheep, Feedlots, Reviews, Sludge disposal, Heavy metals, Adsorption, Cadmium, Nutrient requirements, Nutrients, Nutrition, Diets, Animal populations, *Recycling, *New Mexico, Las Cruces, Albuquerque.

For the past six years New Mexico State University (NMSU) has been conducting extensive research on the feasibility of recycling sewage products as livestock feedstuffs. Sewage solids used in the NMSU research were collected as primary settled solids at treatment plants of Albuquerque and Las Cruces, NM, both of which have minor inflows from industry and low levels of cadmium. Sludges were dried, bagged, sealed and gamma-irradiated to an absorbed dosage of 1 mega-rad using cesium-137. In most of the studies conducted with ruminants, the digestibility of the energy content in sewage products was about 60%, digestibility of nitrogen was about 70%, and retention of absorbed nitrogen was about 60-70%. Experimental supplements containing one-half or more of the dry matter as dried, irradiated sewage solids were

fed to cows on arid range during three or four months each year for over four years. Improved performance was recorded compared to unsupplemented diets. Two feedlot trials were conducted with cattle fed sewage solids as 12 to 15% of diet for two or three months to measure uptake of heavy metals and halogenated hydrocarbons into organs and tissues. A bioassay of meat quality was performed as a multi-generation feeding trial with albino rats. Overall the data suggest that dried sewage solids from primary sludge can be sterilized and substituted for conventional, higher-priced feeds for ruminants without adverse effects on reproductive or feedlot performance. Feeding dried gamma-irradiated sewage solids to ruminants produced no evidence of animal toxicity nor a hazard to human health during six years of study. (Baker-FRC)
W82-06489

OCEAN DUMPING BATTLE MARCHES ON,
N. Goldstein.
Biocycle, Vol 23, No 3, p 27-31, May/June, 1982. 2 Fig.

Descriptors: *Sludge disposal, *Ocean dumping, Waste disposal, Sludge, Wastewater management, Legislation.

A study by the National Advisory Committee on Oceans and Atmosphere was released in January of 1981 which stated that the role of the oceans is a positive one in waste management strategy, and that the ocean has the ability to assimilate waste products. Ocean disposal of sewage sludge was encouraged in the report as an option in areas where no unreasonable degradation of the environment would result. Appropriate management conditions and adequate monitoring safeguards were considered essential. This finding enabled New York City to file suite against the EPA for refusing to grant an extension to the city's interim ocean dumping permit. The House Oceanography, Fisheries and Wildlife Conservation, and Environmental Subcommittees have endeavored to present amendments which would close the loophole through which New York City had passed. Joint hearings on the draft legislation were held in Washington in late March 1982. The amendments offered to the Marine Protection, Research and Sanctuaries Act were starting point for clearing up some of the ambiguities of the present Ocean Dumping Act; a second draft was proposed in late April. The basic thrust of the bill/amendments is to allow EPA some leeway in reviewing ocean dumping application permits. If a sludge is deemed suitable for ocean dumping, the bill is set up to give the EPA administrator a chance for a second test to determine if the sludge is clean enough to be applied to land. (Baker-FRC)
W82-06490

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,
CH2M/Hill, Redding, CA.
For primary bibliographic entry see Field 3C.
W82-06507

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5B.
W82-06518

SELECTION OF WASTE DISPOSAL SITES,
Illinois State Geological Survey Div., Champaign.
K. Cartwright.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 197-201. 1982. 37 Ref.

Descriptors: *Waste disposal, *Site selection, *Leachates, *Fate of pollutants, Landfills, Geohydrology, Groundwater pollution, Groundwater movement, Hydraulic conductivity, Groundwater recharge.

Selection of sites for waste disposal must consider the hydrological factors of hydraulic conductivity, relationshiip to groundwater systems, and the geochemical interaction of the leachate with the media. In general, earth materials with low hydraulic conductivity (on the order of 10 to the minus 6th power cm per sec or less) reduce contaminants to acceptable levels within tens of ft from the disposal site. Any contamination is associated with springs or streams on or very near the site. If hydraulic conductivity of the earth materials is on the order of 0.01 cm per sec or greater or the rocks are fractured, contaminants at dangerous concentrations may travel for hundreds or thousands of ft. The presence of a sand layer will amplify the horizontal movement of the groundwater flow. In humid regions it is almost impossible to find a disposal site not in a groundwater recharge or discharge area. Recharge areas require more thorough investigation of the groundwater flow path because of the downward movement. In discharge areas leachate paths are generally short, near the surface, and easier to confirm. It is often practical to recover all or part of the leachate in discharge areas. Disposal below the water table may produce large volumes of leachate, odorous gases, and operational difficulties with earth moving machinery. Disposal above the water table may be difficult because low water table regions often have very permeable overlying material, unsaturated earth may transmit undesirable gases, and leachate may be difficult to collect. The hydraulic conductivity of the earth is much more important than whether a site is above or below the water table. The geochemical reactions in a waste disposal site are complex. However, in general, reactions are controlled by anion and cation exchange, buffering capacity of the soil, and dilution. (Cassar-FRC)
W82-06550

LANDSPREADING OF SLUDGE IN NEW YORK STATE,
D. A. Fagan.
Biocycle, Vol 23, No 3, p 57-61, May/June, 1982.

Descriptors: *Sludge disposal, *Land disposal, Sludge, Wastewater management, Waste disposal, Soil disposal fields, Legislation, Regulations, Legal aspects, *New York, Wastewater disposal, Wastewater treatment.

A moratorium on the landspreading of sewage sludge on certain agricultural soil types was executed in New York State in March of 1981. The purpose of the two year moratorium was to provide sufficient time for the federal government to establish a definitiv policy on the use of sewage sludge for land application purposes. Currently the Department of Environment and Conservation (DEC) in conjunction with Agriculture and Markets is completing a draft Environmental Impact Statement (EIS) on the sludge moratorium. Tentative plans called for this draft to be completed in March of 1982, with public hearings following 30 days later. Current sludge management regulations in New York are contained in two sections of the State Environmental conservation Law. In May of 1981 DEC published guidelines designed to help solid waste management applicants, including sludge landspreaders, meet the regulations so as to obtain the construction or operating permits needed. The most important aspect of the guidelines and regulations involves the requirement for permit applicants to develop a management plan including a monitoring and recordkeeping program. Compared to past landspreading practices, the major changes in the guidelines and regulations relate tothe requirements for incorporating surface applied sludge into the soil the same day it is spread, and the prohibition of surface application to frozen or snowcovered ground. The effects of these guidelines on cost of operating a land disposal system are discussed. (Baker-FRC)
W82-06557

OCEAN DUMPING OF SLUDGE VS. THE ALTERNATIVES,
Clinton-Bogert Associates, Fort Lee, NJ.
I. L. Bogert, and L. J. Sokol.
Water Science and Technology, Vol 14, No 3, p 1-8, 1982. 3 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, Water pollution effects, Bergen County, New Jersey, Environmental effects, Cadmium, Mercury, Polychlorinated biphenyls, DDT, Heavy metals, Landfills, Incineration, Fish, Aquatic life, Bioaccumulation, Regulations.

The environmental effects of ocean dumping of sludge and land-based disposal alternatives were evaluated using Bergen County, New Jersey, digested sludge. Problems with land disposal include airborne Aspergillus fumigatus spores emanating from the composting site and high heavy metal concentrations in the sludge. Bergen County digested sludge contained (in micrograms per liter liquid phase): Hg, 45.2; Cd, 330; polychlorinated biphenyls, 4.4; and DDT, < 0.05. If this sludge is discharged in the ocean at the permitted barge speed and discharge rate, dilution is 5200:1, producing diluted concentrations of less than the water quality criteria. Bioassays of the suspended particulate phase of the sludge indicated that the LC50 in the worst case was 150:1 dilution of sea water: sludge or 6700 mg per liter. Ten days of exposure of grass shrimp, hard clams, and Atlantic silversides to the suspended particulate phase (containing Cd, Hg, PCB, and petroleum hydrocarbons) indicated no statistical difference in bioaccumulation as compared with controls. The authors conclude that ocean dumping is less environmentally damaging than land disposal and that the site 12 miles from shore in the New York Bight should not be abandoned for a proposed 106 mile distant site. (Cassar-FRC)
W82-06590

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,
Thames Water Authority, London (London).
J. L. Dakers, and R. P. King.
Water Science and Technology, Vol 14, No 3, p 53-59, 1982. 2 Tab, 2 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Industrial wastewater, Fate of pollutants, Land disposal, Thames Water Authority, Mercury, Cadmium, Nickel, Zinc, *Heavy metals, Metals, Wastewater analysis, Water quality standards, *England.

Toxic heavy metals levels in sewage sludge discharged into the ocean from the Thames Water Authority plants were reduced by controlling metals levels reaching the municipal treatment plants. The high concentration of Hg in Beckton plant sludge was reduced from 19 mg per kg in 1975-76 to 14 mg per kg by limiting Hg in effluents from a single organo-mercurials manufacturing plant. Cd, Cu, Ni, and Zn in sludges from the Mogden plant, which are applied to land, were also decreased by control of metals in trade effluents. Effluents from potential metal discharges in several sewage works regions were sampled regularly for several months to a year to provide information on the total load of metals entering the sewage works and the total load contributed by industry. The difference between the two values was the amount derived from domestic sources. As an example, the data for Cd are given for several treatment plants. Existing Cd loads received at two of the works were 7.9 and 7.7 kg per day, producing sludge concentrations of 46 and 40 mg per kg, respectively. Contributions by trade effluents were 61-70%. Reducing the Cd concentrations in effluents received at the plant to 1 mg per liter would reduce the Cd in finished sludge to 32 and 16 mg per kg, respectively. Although uniform limits on metal levels are superficially attractive, flexibility in administering the guidelines is urged to prevent expensive and stringent controls in cases where these will not significantly improve the quality of the sludge. (Cassar-FRC)
W82-06592

SLUDGE DISPOSAL TO SEA IN FRANCE,
Centre d'Estudes et de Recherches de Biologie et d'Oceanographie-Medicale, Nice (France).
M. Aubert, M. J. Gauthier, and J. Aubert.
Water Science and Technology, Vol 14, No 3, p 169-182, 1982. 8 Fig, 2 Tab, 13 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Bacteria, Wastewater treatment, Wastewater disposal, *France, Particulate matter, Fate of pollutants, Outfalls, Suspended solids, Self purification.

A review of the nature of the polluting elements of sewage water and the interactions between bacteria and particulates in sludge is presented. A mathematical formulation of the dynamics of suspended matter in the sea is established. The initial concentration of bacteria at the point of surfacing is obtained from the concentration of bacteria in the sewage water before release, drift time, a depth of discharge coefficient, an outfall coefficient, and a coefficient for bactericidal action of sea water. Another similar equation expresses the spread of matter not subject to bactericidal action. Injecting wastewater below the thermocline reduces chances of rapid resurfacing, especially if diffusers are used. At the lower depths self-purification is not very efficient. Several types of wastewater treatment are used in France: pretreatment (removal of solids, oil, and grease--usually burned); primary treatment (carried out in lagoons or pools); and secondary or tertiary treatment (purification by chemical or biological means with sludge digestion in anaerobic digesters). The digested sludge produced by these processes is disposed of on land as fertilizer or as fill in road surfaces. Sea disposal of sludge has been tried with poor economic success at St. Tropez. The Interministerial Group for Problems of Sea Pollution in 1973 condemned the practice of coastal communities discharging untreated sewage into the sea. For financial reasons the establishment of treatment plants has been delayed. Of first concern is removal of solid matter, oil, and bacteria. (Cassar-FRC)
W82-06593

MATHEMATICAL MODEL INVESTIGATION OF FAR-FIELD TRANSPORT OF OCEAN-DUMPED SEWAGE SLUDGE RELATED TO REMOTE SENSING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. Y. Kuo.
Water Science and Technology, Vol 14, No 3, p 33-39, 1982. 2 Fig, 8 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Fate of pollutants, Model studies, Mathematical models, *Remote sensing, Diffusion coefficients, Plumes, Particle distribution, Particle size.

The far-field transport processes of sewage dumped in the New York Bight were examined by a modification of a three-dimensional Eulerian-Lagrangian finite difference model. The model provides information on the effect of the magnitude of the horizontal and vertical diffusion coefficients and the particle density and size distribution on the sludge plume as it changes with time. The sludge plume was also studied for general trends of spreading, contours of equal concentration, and maximum sludge concentration at a given time after dumping. Model inputs were velocity field, sea conditions, diffusion coefficients, sludge characteristics, and dumping rate. Both ground truth data and remote sensing data were compared with model results. Agreement on trend of plume growth was fairly good between model results and remote sensing data. Concentrations obtained from averaging over the top 2, 4, and 8 ft were significantly different. Generally, integration over the top 8 ft indicated higher concentrations than the others. (Cassar-FRC)
W82-06594

DISPOSAL OF SLUDGE TO SEA,
Oslo Commission (Norway).
H. R. Neilson.
Water Science and Technology, Vol 14, No 3, p 145-152, 1982.

Descriptors: *International agreements, *Sludge disposal, *Ocean dumping, Land disposal, Oslo Commission, Paris Commission, Helsinki Convention, Barcelona Convention, Water quality control, Legislation, Legal aspects, London Dumping Convention.

The role of international conventions in marine dumping of sludge was the subject of the introductory paper in a conference on disposal of sludge to the sea. The aim of the International Conventions (Oslo Commission on sea dumping, Paris Commission on pipeline discharges, Helsinki Convention on the Baltic, and the Barcelona Convention on the Mediterranean) is to prevent marine pollution through the coordination of the separate control measures exercised by individual countries. The conventions provide a forum for discussion and try to make decisions by mutual agreement rather than by vote. Problems facing waste disposal personnel are increasing amounts of sewage, expanding and increasingly complex industrial wastes, environmental lobbies, and the world economic recession. The international conventions can lead the effort to coordinate scientific resources to tackle recycling of sludges and long term strategies. The author suggests that regional conventions can control marine pollution better than global conventions because each region requires individual consideration. The global London Dumping Convention is the ideal body for coordination of regional conventions. In 1984 the end of the first decade of the Oslo Convention will be celebrated by publishing the achievements and results of scientific and monitoring studies. (Cassar-FRC)
W82-06595

SLUDGE DISPOSAL STRATEGY: A UK VIEWPOINT,
National Water Council, London (England).
D. L. Walker.
Water Science and Technology, Vol 14, No 3, p 127-136, 1982.

Descriptors: *Sludge disposal, *Ocean dumping, United Kingdom, Land disposal, Agriculture, Incineration, International agreements, Research priorities, Water policy.

This paper describes the world attitudes and the United Kingdom policies toward sewage sludge disposal. The Water Act of 1973, which organized 10 all-purpose water authorities in England and Wales, placed sewage disposal under the jurisdiction of the water authorities. This responsibility belongs to regional councils in Scotland and to the Department of Environment in Northern Ireland. Water authorities must dispose of sludge within legal constraints and must consider farmer's attitudes toward land disposal. The Ministry of Agriculture Fisheries and Food issues permits for sludge disposal at sea. In England and Wales the 1.2 million tons (dry weight) per year of sludge produced was disposed of in 1977 in the following ways: 48% on farm land, 24% on landfills, 24% at sea, and 4% incinerated. Methods, guidelines, hazards, safeguards, and problems associated with disposal of sludge on land, at sea, by incineration, and by other methods are described. England and Wales do not dump sludge unsuitable for land treatment into the ocean. Pretreatment is required to control levels of toxic metals or other materials. Contaminated sludge is incinerated. Water authorities favor sea disposal as an economic method for sludge disposal. Water authorities are concerned with the total load of pollutants entering waters from all sources. Restraints will not be applied to sludge disposal without also controlling discharges to rivers and tidal waters. The costs of sludge disposal represent 10% of total consumer bills. Sophisticated methods of sludge disposal can easily double disposal costs without significantly improving safeguards to the environment. The water authorities plan to retain flexibility of choice in sludge disposal options. (Cassar-FRC)
W82-06596

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
C. F. Guarino, and S. Townsend.
Water Science and Technology, Vol 14, No 3, p 153-161, 1982. 9 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Legislation, Water law, Judicial decisions, Regulations, Legal aspects, Permits, Water quality control, Water pollution effects, Heavy metals, Philadelphia, Pennsylvania, New York.

Sludge disposal legislation in the U.S. is complex and confusing. At least 12 different Federal laws govern sludge disposal. In addition, there are conflicting regulations and policies for implementing the laws. The Marine Protection Act (1972) was designed to regulate dumping into ocean waters of any material which would adversely affect humans, the marine environment, ecological systems, or economic potentials. Permits were required to regulate the amount of hazardous materials entering the ocean. Case studies of sludge disposal in two cities are given. Philadelphia, Pennsylvania, was required to end ocean dumping of sludge after issuance of an EPA report, widely criticized for its lack of objectivity and of scientific evidence of harm to the environment. As a result, ocean dumping was ended by the required deadline and land disposal was implemented at significantly greater costs. In contrast, New York was allowed to continue dumping sludge in the heavily polluted New York Bight after the December 31, 1981, deadline prescribed by the law. (Cassar-FRC)
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,
W. F. Garber.
Water Science and Technology, Vol 14, No 3, p 109-125, 1982. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Legislation, Water law, Legal aspects, Water quality standards, Waste disposal, Water pollution control, Philadelphia, Pennsylvania, Los Angeles, California, Outfalls, Environmental effects, Wastewater treatment, Wastewater disposal, Pulp wastes, Toxicity, Aquatic life, Santa Monica Bay, Heavy metals, Metals.

Sludge disposal to the sea in the United States is a subject of controversy. Laws and regulations concerning waste disposal are conflicting and make environmentally responsible solutions to problems difficult or impossible to attain. Legislation treats air, water, and land pollution separately. For example, an industry or municipality wishing to dispose of its wastes may find it prohibitory or difficult to incinerate (Clean Air Act), to dispose at sea or in inland waters (Federal Water Pollution Control Act), to dump from ocean barges (Marine Protection, Research, and Sanctuaries Act), and to dispose on land or in deep wells (Safe Drinking Water Act). Case studies of three cities are given to illustrate existing attitudes. Philadelphia, Pennsylvania, was prohibited by the EPA from dumping sewage sludge into the ocean despite lack of evidence of harm to the marine environment. Los Angeles, California's Hyperion treatment facility was allowed to continue sewage disposal through three ocean outfalls when it was shown that this disposal method was the most environmentally sound. Two paper companies discharging carbohydrate wastes deep in the ocean in an area of excellent mixing were ordered to dispose waste on land in spite of the negative environmental impact of land disposal. These cases illustrate the disadvantages of applying laws uniformly throughout the nation without considering the great differences in individual situations. Recent regulations result in standards sometimes lower than the best techniques can detect and in standards lower than concentrations in pristine water supplies. However, some trends toward more consideration of scientific evidence and evaluation of individual cases are apparent. (Cassar-FRC)
W82-06598

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,
D. C. Macleod.
Water Science and Technology, Vol 14, No 3, p 93-107, 1982. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Outfalls, *Ocean dumping, Durban, *South Africa, Heavy metals, Water quality, Bacteria, Aquatic life, Inverte-

brates, Water pollution effects, Wastewater disposal, Settleable solids, Fate of pollutants.

The performance and effects on the marine environment of two sea outfalls at Durban, South Africa, are reported. Previously published monitoring data on ocean currents, dilution, and onshore frequency are reviewed. Originally the outfalls were designed for discharge of settle effluent but during 1970-71 it was necessary to discharge raw sewage through Bluff Outfall. As of January 1978 the 1 ml per liter settleable solids limit was changed to 2 ml per liter to allow for discharge of sludge with the settle effluent. Scum, grease, and floatable objects are totally removed so that the sludge is in finely divided form. Surf zone water quality is shown on a bar graph for 26 stations and at the two outfalls for the years 1964-1981. In general, water quality at the beaches near the Southern (Umlaas) Outfall is poorest. Predominant organisms from sediment samples are nematodes, polychaetes, oligochaetes, archiannelids, and isopoda. (Cassar-FRC)
W82-06599

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,
Umweltbundesamt, Berlin (Germany, F.R.).
D. Fuchs.
Water Science and Technology, Vol 14, No 3, p 163-168, 1982. 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, *Federal Republic of Germany, Aquatic life, Fish, Hamburg, Landfills, Agriculture, Heavy metals, Metals, Land application, Industrial wastes, Permits Legislation, Water pollution effects.

In Germany land disposal of sludge is given priority over sea dumping. Only sewage sludge is dumped into the ocean. Industrial wastes are treated on land. The only city dumping sludge into the sea is Hamburg, which has disposed of 18,000 metric tons (dry weight) each year since 1962 in the North Sea)Inner German Bight). This amounts to 1% of the 1.8 million tons (dry) of sewage sludge produced in the country. The present dumping permit for Hamburg, which expires in 1983, is not expected to be renewed or extended. The dumping area is considered an endangered biological system according to scientific studies. For example, fish have suffered increased sublethal damage and disease and decreases in species numbers and richness. Heavy metals contents in sediments are suspended matter have increased, and bottom waters suffer from oxygen depletion in summer. Sludge disposal on land has been 40% for agriculture, 55% by land fill, 10% by incineration, and 5% other. (Cassar-FRC)
W82-06600

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),
Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
L. Tent.
Wasserwirtschaft, Vol 72, No 2, p 60-62, February 1982. 2 Fig, 3 Tab, 18 Ref. English Summary.

Descriptors: *Heavy metals, *Spoil banks, Agriculture, Harbors, *Dredging, Suspended solids, Cadmium, Waste disposal, Soil properties, Hydrogen ion concentration, Alkalinity, Plant growth, Estuaries, Elbe river, Rivers, Tidal rivers, Water currents, *West Germany.

Polders made up of material dredged from the harbor of Hamburg, West Germany, were tested for suitability for agricultural application. The port of Hamburg is situated in the upper limnic portion of the tidal Elbe River estuary, where the current is weak. Consequently, suspended solids transported from upriver accumulate in the harbor. Heavy metals have been found in dredged material in concentrations ranging from 7-25 mg/kg for cadmium, 250-600 mg/kg for copper, and 1500-2500 mg/kg for zinc. Cadmium levels measured in polders formed before 1970 and used for agriculture and in those formed after 1970 and not used agriculturally showed no clear reduction with time. The nutrient content of the polder soil is high and favorable to plant growth, and the high chalk content and buffer capacity mean that the soil is weakly alkaline and that the heavy metals are not taken up by plants. However, if the chalk used by plants or leached out is not replaced adequately, the pH is reduced and plants begin to absorb heavy metals. This has led to a decrease in the quality of grain produced on some polders. Research into methods of improving soil contaminated in this way, into the hydrology of polders, and into new technology for treatment and disposal of dredged material is being performed. (Gish-FRC)
W82-06637

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,
Northumbrian Water Authority (England).
J. M. Eno.
Water Pollution Control, Vol 81, No 1, p 37-44, 1982. 4 Fig, 2 Ref.

Descriptors: *Outfall sewers, *Ocean dumping, Wastewater outfall, Water pollution sources, Water pollution prevention, Wastewater treatment, Wastewater facilities, Screens, United Kingdom, Coastal waters, Performance evaluation.

There are more than 100 outfalls of various sizes discharging sewage or surface water to the sea along the Northumbrian coastline. However, only 13 of the 64 foul-sewage outfalls currently employ any form of preliminary treatment. Although the 26 district councils are responsible for the pretreatment facilities at the head of coastal outfalls from public sewerage systems, the Northumbrian Water Authority has been involved in the design and operation of these facilities since 1974. Pretreatment plant design criteria are outlined. Screens in a rotating drum configuration have been found to be the only screening devices capable of ensuring 100% compliance with maximum particle size requirements for discharges. The design configurations and process performance of four existing screening installations at ocean outfalls on the northeast coast are described. Reviews of the operation of these plants have led to several significant conclusions regarding factors affecting the process reliability of drum screening installations. The diameter of the holes forming the mesh in thin steel plates appears to be critical to continuity of process performance. These holes should be no larger than 4 millimeters in diameter. For optimal results, thicker plastic plate is preferable to thin steel plates. Techniques for the continuous cleansing of screen surfaces in both cup and drum configurations also appear to be critical to process performance. The principle of recycling generally results in more economical development and operation of screening installations at pretreatment plants on coastal outfalls as compared with batch-type operations requiring extraction, processing, and removal of screenings. Large plants are preferably to be located in the open air, provided that adequate attention is given to such amenity considerations as odor and unobtrusiveness of the plant. (Carroll-FRC)
W82-06645

HEAVY METALS IN SLUDGE--ARE THEIR TOXIC EFFECTS ADDITIVE,
Oxford Univ. (England). Dept. of Agricultural Science.
P. H. T. Beckett, and R. D. Davis.
Water Pollution Control, Vol 81, No 1, p 112-119, 1982. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Heavy metals, *Toxicity, *Sludge, Sludge disposal, *Copper, *Zinc, *Nickel, Regulations, Crop yield, Barley, Pollution load, Land disposal, Phytotoxicity.

The amount of sewage sludge which can be safely disposed to agricultural land is highly dependent on whether or not the toxic effects of the copper, nickel, and zinc components are additive. While draft regulations in the United States and several European countries assume that these effects are not additive, those for the United Kingdom assume that they are. The concentrations of copper, nickel, and zinc in soil solutions of sludge-treated soils were investigated and the toxicity to young barley of solutions containing individual metals or mixtures of two metals was examined in an effort to establish the likely extent of additivity. These tests showed that, in the range of solution concentrations that is of practical concern, the relationship between tissue concentrations and soil solution concentrations is roughly linear, and that the relationship between soil solution concentration and heavy metal load is concave downwards. Tissue concentrations of copper, nickel, and zinc in crops on sludge-treated soils are likely to be proportional, or less than proportional, to the heavy metal load of the soil. Copper, nicke, or zinc are not likely to contribute to the total toxicity unless their quantity exceeds 50 to 67% of the quantity that would be just sufficient to cause toxicity in the absence of the other elements. These results indicate that the three elements show less additivity than is assumed in the draft regulations in the United Kingdom, but a little more than is assumed in the U.S. regulations. It would appear that sludge application rates in the United Kingdom could be doubled without increasing the risk of environmental pollution. (Carroll-FRC)
W82-06646

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,
Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-06767

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-06772

LAND APPLICATION OF WASTEWATER,
Montgomery (James M.), Salt Lake City, UT.
J. H. Reynolds.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 673-675, June, 1982. 26 Ref.

Descriptors: *Literature reviews, *Water reuse, *Reclaimed water, *Irrigation water, *Land disposal, *Reviews, Impaired water use, Nutrients, Nitrogen, Phosphates, Pathogens, Bacteria, Viruses, Microorganisms, Municipal wastewater, Forages, Pastures, Water pollution effects, Soil properties, Wastewater disposal, Wastewater irrigation, Fate of pollutants, Sugarcane, Cotton, Public health.

The published literature on recent developments in land application of wastewater was reviewed. Case studies of successful application of secondary wastewater effluents were reported for grassland, sugarcane and cotton crops, and in a southern Appalachian forest. Nitrogen removal and heavy metal accumulation by different forage crops were studied. Nitrogen balances at wastewater disposal sites showed that a significant fraction of nitrogen was lost by denitrification and volatilization. Drained, cultivated, organic soils; flooded organic soils; and shallow reservoirs efficiently removed nutrients from wastewater effluents. Microbiological die-off exhibited first-order kinetics. Die-off rates were 1.14 per day for fecal coliforms, 1.33 per day for Salmonella, and 1.45 per day for viruses. Depth to groundwater was an important factor in the attenuation of pathogens in the soil. Effects of land application on the health of workers and other exposed populations, on the quality of ground and surface waters, on the food chain, and on soil physical properties were studies. (Cassar-FRC)
W82-06915

RADIOACTIVE WASTES,
Oak Ridge National Lab., TN., Environmental Sciences Div.
B. G. Blaylock, and H. J. Alexander.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 1002-1023, June, 1982. 4 Tab, 193 Ref.

Descriptors: *Literature reviews, *Waste disposal, *Radioactive waste disposal, *Nuclear wastes, Waste storage, Water pollution sources, Fate of pollutants, Underground waste disposal, Solid wastes, Regulations, Geohydrology, Landfills, Ocean dumping, *Reviews, Incineration, Storage, Waste management, Aquatic life, Monitoring, Risks, Powerplants, Environmental effects, Financing, Economic aspects.

A review of the radioactive waste literature for 1981 listed the contents of 3 symposia in tabular form. Recent regulations published by the Nuclear Regulatory Commission, Department of Energy, and EPA were highlighted. Studies on the isolation of radioactive wastes included hydrogeological investigations of the suitability of different host rocks and sites for waste burial. It was determined that groundwater moves mainly through macrofissures and is nearly stationary in the adjacent micropores. Pressure gradients caused by the temperature differences were important. Shallow land burial of low-level waste in polyethylene drums was done satisfactorily. Several handbooks and reviews on geologic repositories were mentioned. Other authors discussed testing and modeling of the suitability of various sites for disposal with consideration of temperature changes, creep in salt formations, effects of seismic events on underground facilities, and ocean disposal. Waste treatment methods reviewed were solidification (such as spent ion exchange beads), vitrification (for example, the MODOX process for immobilizing Na ions and radionuclides in a glass matrix), volume reduction (melt refining, treatment of ion exchange resin waste, glass furnace, use of metals and slags, and chemical reactions plus filtrate of I131 wastes), and incineration. Studies on migration of radionuclides in the environment included monitoring of aquatic and terrestrial organisms, sediments, and water. Several models were developed to describe transport of radioactive materials in water, soil, and food webs. Methods used for monitoring at radioactive materials facilities such as powerplants included soil sampling, collecting wind-suspended dust, and sampling of drainage ditch water. Other topics discussed were waste management, storage, transportation, risk assessment, remedial action such as sealing uranium mill tailings sites with asphalt emulsion barriers, decomissioning nuclear facilities, and socioeconomic factors. (Cassar-FRC)
W82-06920

A CASE FOR REGIONAL SLUDGE MANAGEMENT,
R. K. Allen.
Public Works, Vol 113, No 7, p 59-62, July, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Incineration, *Transportation, Maynard, *Massachusetts, Wastewater treatment, Regional planning, Sludge thickening, Liquid sludge, Dewatering, Landfills, Land disposal, Costs, Operating costs.

Regional sludge management was advantageous for the town of Maynard, Massachusetts, for two reasons: cost effectiveness and improvement of effluent quality. The 1 mgd wastewater treatment plant at Maynard had experienced many problems with its fluidized bed sludge incinerator since startup in 1975, and management resorted to on-site landfilling of undigested sludge. In addition, discharge standards were violated 55 and 26 days per year for BOD and total suspended solids, respectively. The problems were solved by trucking liquid sludge to the Greater Lawrence Sanitary District, a 39 mgd capacity secondary treatment facility, equipped for sludge thickening, dewatering, and incineration. Costs per dry ton were as follows: onsite landfill, $250; fluidized bed incinerator, $620; and liquid sludge hauling, $323. Although landfilling was the cheapest alternative, there had been many complaints of obnoxious odors. Hauling sludge also decreased the number of days on which maximum discharge standards were violated to 15 and 18 for BOD and total suspended solids, respectively. A figure compares the annual operation and maintenance costs of on-site incineration and hauling for 10-100 miles, one-way, at flows up to 100 mgd. Cost effectiveness is also shown in graph form. It is more cost effective to incinerate on site above 10 mgd. At lesser flows, the cost effectiveness depends on hauling distance. For example, for a 2 mgd plant it is more cost effective to haul sludge up to 80 miles one-way; for a 6 mgd plant, it pays to haul only 15 miles one-way or less. (Cassar-FRC)
W82-06993

5F. Water Treatment and Quality Alteration

INFLUENCE OF OZONATION ON SULFUR, NITROGEN, CHLORIDE AND PHOSPHORUS SYSTEMS IN PUBLIC DRINKING WATER SUPPLIES,
South Dakota State Univ., Brookings. Dept. of Chemistry.
D. C. Hilderbrand.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243320, Price Codes: xx in paper copy, A01 in microfiche. Report, May 1982. 15 p, 7 Tab, 4 Ref. OWRT B-069-SDAK(1), 14-34-0001-1264.

Descriptors: *Ozone, *Water treatment, *Sulfur, *Nitrogen, *Chloride, *Phosphorous, Ammonia, Public utility, *Ozonation, Water supply, Sulfate, Phosphate, Drinking water, Potable water.

The use of ozone as a treatment process for public drinking water is of interest because other methods include a concern relative to the ingestion of chloroform and other trihalomethanes. Ozone which decomposes rapidly in water to form oxygen deters the possibility of formation of other hazardous species. Most studies on ozonation have dealt with sterilization, color, taste, and odor removal. This study investigated the effect of ozonation on the concentration of selected phosphorus, sulfur, nitrogen and chloride species present in raw drinking water supplies. The following observations were made. No effect on the concentration of either phosphate or chloride was detected. The concentration of sulfide and sulfite was reduced to below detection limit of the method used when intermediate or high concentrations of ozone was applied. The concentration of sulfide was only slightly elevated corresponding to the conversion of limited amounts of sulfite to sulfate. For the nitrogen system no effect was detected for treatment of samples containing ammonia. The nitrite concentration however was reduced to below the detection limit for the method when intermediate and high levels of ozone treatment were employed.
W82-05907

DESALINATION DIRECTORY 1981.
Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
For primary bibliographic entry see Field 3A.
W82-05908

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,
Missouri Water Resources Research Center, Columbia.
M. M. Ghosh, and T. M. Prakash.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243551, Price codes: A04 in paper copy, A01 in microfiche. Report, January, 1982. 55 p, 9 Fig, 10 Tab, 39 Ref. OWRT A-122-MO(1). 14-34-0001-1127.

Descriptors: *Water quality control, *Microbial degradation, *Drinking water, *Biochemical tests, *Bioindicators, Microorganisms, Potable water, Water analysis, Bacterial analysis, Stream degradation, Biochemistry, Organic carbon, Natural waters, Monitoring, Pollutant identification.

Research was focused on delineating the role of microorganisms in drinking water quality degradation, which can occur during water transport in pipe networks. Biofouling kinetics were studied at very low (glucose) substrate levels in simulated systems using continuous stirred-tank reactors. Biofilm growth was measured on glass slides suspended in single reactors inoculated with indigenous microorganisms present in the University tap water. Extremely dilute feed solutions were used to simulate low (5-15 mg/liter) total organic carbon (TOC) conditions typical of actual water distribution systems. Biofouling was quantitatively estimated from biofilm thickness, attached biomass and its ATP level, biofilm polysaccharides, and changes in TOC and dissolved oxygen. It was found that biofilm kinetics under low substrate conditions were similar to literature values. The substrate penetrated the entire biofilm thickness, indicating no substrate limitation. Substrate consumption rate was linear with substrate loading rate and oxygen consumpton rate. It was concluded that ATP measurement of the biofilm is a good indicator of biological activity. An ATP index is proposed for possible use for water quality change monitoring. (Zielinski-MAXIMA)
W82-05932

PLANT EXPANSION VIA HIGH-RATE PRE-TREATMENT,
Alabama Water Works, Birmingham.
C. D. Colee, and K. W. Henderson.
Public Works, Vol 113, No 5, p 84-86, May 1982. 1 Fig, 3 Tab.

Descriptors: *Settling tanks, *Turbidity, *Water treatment, Tube settlers, *Alabama, Birmingham, *Pretreatment.

Tube settlers were chosen as a cost saving means of expanding the capacity of the Western Filter plant in Birmingham, Alabama. A 7-month study compared operation of Basin No 2, operating at the 5 mgd conventional rate without tube settlers, and Basin No. 1, operating at rates up to 20 mgd and equipped with 3600 sq feet of tube settlers and an additional 480 linear ft of weirs. Settled water turbidities from the 2 basins were comparable. Total capacity of the plant will be expanded from 440 to 60 mgd when tube settlers are also installed in Basin No. 2. (Cassar-FRC)
W82-05953

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,
Kyoto Univ. (Japan). Dept. of Chemical Engineering.
E. Sada, S. Katoh, K. Miyai, M. Terashima, and S. Yoshida.
Biotechnology and Bioengineering, Vol 24, No 5, p 1137-1144, May, 1982. 8 Fig, 1 Tab, 4 Ref.

Descriptors: *Solute transport, *Membrane processes, Permeability, Filtration, Sieving coefficients, Hydraulic properties, Water treatment.

Homogeneous kappa-carrageenan and bovine serum albumin membranes used in reverse osmosis and other applications were evaluated. Solutes included urea, B vitamins, enzymes, and other substances with molecular weights from 60 to 68,000. The rates of hydraulic transport of water, solute permeabilities, and sieving coefficients increased with the water content of membranes. Water content, in turn, was related to pore radius. As the molecular weight of the solute increased, the ratio of diffusion coefficient of the solute in the membrane to the diffusion coefficient of the solute in water decreased, the reciprocal of the membrane thickness times the membrane resistance increased, and the sieving coefficient decreased. (Cassar-FRC)
W82-06006

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,
Compagnie Generale des Eaux, Paris (France).

For primary bibliographic entry see Field 5G.
W82-06013

PACKAGED PLANT TREATS TURBIDITY,
Mesa Engineering and Surveying Co., Inc., Montrose, CO.
R. A. Burnham, and W. C. Trnka.
Water/Engineering and Management, Vol 129, No 4, p 56-57, April, 1982.

Descriptors: *Turbidity, *Water treatment, Ridgway *Colorado, Flocculation, Package plants, Drinking water, Snowmelt.

The water supply of Ridgeway, Colorado, population 270, is pure at the source but becomes contaminated with organic and inorganic matter during its travel through 6 miles of open ditch. Turbidity is especially high during the spring snowmelt period. A package plant was installed (total cost $780,000) to upgrade water quality. The treatment process consists of flocculation with alum and cationic polymer, a depth clarifier, sand depth filters, and chlorination. The equipment treats 130,000 gpd. The facility delivers water 10 times better in quality than minimum specified standards. (Cassar-FRC)
W82-06026

FLORIDA STYLE WATER SUPPLY AND TREATMENT,
CH2M Hill, Gainesville, FL.
O. K. Buros, T. A. Ridgik, C. R. Sproul, M. R. Vilaret, and R. A. Yorton.
Water/Engineering and Management, Vol 129, No 4, p 30-33, April 1982. 3 Ref.

Descriptors: Water supply, *Water softening, *Aquifers, *Water treatment, Coastal aquifers, Sulfides, Desalination, Trihalomethanes, Chlorinated hydrocarbons, Organic matter, Hardness, Saline water intrusion, Flocculation, Aeration, Chlorination, Activated carbon, Brackish water, Water quality control, Reverse osmosis, Electrodialysis, Membrane processes, Distillation, *Florida.

Florida's abundant precipitation (163 million acre feet per year) recharges the very productive Floridan aquifer underlying most of the state and the smaller Biscayne aquifer under the southeast coast. Groundwater provides almost 90% of the state's public supply. Florida's most prevalent problems with its water supply are hardness (high Ca, low Mg), high hydrogen sulfide levels, salt water intrusion, and trihalomethane (THM) formation. As a result, treament methods have evolved. Water softening with lime or lime-soda ash is widespread. Many softening plants use potato starch as a flocculant aid to improve the sludge handling characteristics. Surface water quality is variable; it is often high in organic color. Treatment usually required is coagulation, settling, filtration, and activated carbon. Aeration has been a common process for removing hydrogen sulfide from waters. However, Orlando is using a new process based on oxidation of sulfides with chlorine prior to passage through a granular activated carbon bed. Methods of handling the salt water intrusion problem include artificial recharge of an aquifer with river water, control of large withdrawals in sensitive areas, raising canal control elevations, and relocation of wells further inland. In areas of abundant brackish water supplies desalination by electrodialysis or reverse osmosis is in use. The combination of high dissolved organic matter and bromide ions in Florida waters favors THM formation. Three possible treatment strategies are available: removal of THM precursors, removal of THM after chlorination, and alternate disinfectants. (Cassar-FRC)
W82-06027

REMOVAL OF HUMIC SUBSTANCES FROM NATURAL WATERS BY REVERSE OSMOSIS,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
H. Odegaard, and S. Koottatep.
Water Research, Vol 16, No 5, p 613-620, May, 1982. 7 Fig, 5 Tab, 5 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, *Humic acids, Water treament, Color removal, Organic matter, Sagelva River, *Norway.

Removal of humic substances from water by reverse osmosis was studied in laboratory units. The raw water from the Sagelva River, Trondheim, Norway, was high in color (average 54 mg Pt per liter). About 72% of the humic substances had molecular weights above 5000. Three reverse osmosis units were used: Osmonics spiral wound Model OSMO 519-SB, DDS plate and frame module Model 20-Lab, and PCI single tube module Model bro mk2. Membrane pore size was the most significant factor influencing permeate quality and product water flux. Pressure had no significant effect on permeate quality but was linearly related to product water flux. The concentration of humic substances in the raw water did not affect the water flux, indicating that the osmotic pressure of the humic materials did not affect the transport mechanism. The best membranes for each unit were: Osmonics SEPA 89 (permeate flux 25 liters per sq m per hour at 15 bars), DDS 865 (permeate flux 1201 sq m per hour at 40 bars) and PCI T2A (permeate flux 90 liters per sq m per hour at 15 bars). Removal efficiencies of the best membranes were 80-97% in terms of permanganate number. The presence of suspended solids in the raw water decreased removal efficiencies. In the case of 130 mg per liter suspended solids as bentonite, reduction was 50% during 3-4 hours. The suspended solids had greater effects at higher operating pressures. (Cassar-FRC)
W82-06045

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,
Massachusetts Univ., Amherst. Dept of Chemistry.
D. Atlas, J. Coombs, and O. T. Zajicek.
Water Research, Vol 16, No 5, p 693-698, May, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Corrosion, *Copper, *Chlorine, *Pipes, Chlorination, Plumbing, Water treatment, Drinking water, Hypochlorites, Hypochlorous acid.

Corrosion of copper water piping was investigated by exposing copper drillings to different concentrations of free chlorine (0 to 10 mg per liter) and different pH (5 and 8) for 24 hours and determining the dissolved copper at different intervals. Free Chlorine, rather than dissolved oxygen, was the agent most responsible for copper corrosion by chlorinated water supplies. Chlorination was more corrosive at the lower pH because of the pH dependence of the HOCl electrode reactions and the fact that hydrochlorous acid is a stronger oxidizing agent than hydrochlorite ion. To minimize copper pipe corrosion it was recommended that the water supply be adjusted to pH of 7-8 after chlorination, using sodium carbonate rather than sodium hydroxide, and that free chlorine be maintained at a level no higher than 2 mg per liter. (Cassar-FRC)
W82-06051

THEY DON'T ACTIVATE THEIR SLUDGE IN LAGOS OR LAHORE,
Loughborough Univ. of Technology (England). WEDC Group.
J. Pickford.
Effluent and Water Treatment Journal, Vol 22, No 3, p 105-107, March, 1982.

Descriptors: *Water treatment, *Developing countries, *Drinking water, *International Hydrological Decade, *Sanitation, Water management, Wastewater treatment, Rural areas, Urban areas, Water supply development, Water scarcity, Potable water, Waste disposal, Latrines.

The 1981-1990 decade, the International Drinking Water Supply and Sanitation Decade, was planned to provide a safe and accessible supply of drinking water to all of the world's population. The greatest benefit of improved water supplies in underdeveloped countries is accessibility of water. Most poor people do not connect disease and health with water quality. Most human excreta disposal in underdeveloped nations is by latrines, as sewerage systems require too much water flow to operate correctly. Where most tap supplies of safe or publicly-treated water are intermittent, contamination in the distribution system often occurs. When more advanced nations provide funds for constructing sewage treatment works, often local authorities lack the funds to staff and maintain the facilities. Unstable governments, politics, and local regious traditions and taboos may also add to the difficulties of providing water and sanitation. It is suggested that developed countries should not try to impose their technology on underdeveloped nations, but rather work with them in finding the sewage disposal and water treatment systems which would operate best within their existing way of life. Reliability in performing routine jobs on schedule and well is seen as a valuable asset to be encouraged in developing nations seeking to establish improved water management technlogies. (Geiger-FRC)
W82-06075

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,
Illinois Dept. of Energy and Natural Resources, Chicago.
S. L. Jarrell.
Document No 82/05, February 1982. 75 p, 16 Tab, 26 Ref, 1 Append.

Descriptors: *Trihalomethanes, *Water quality standards, *Water supply systems, Pollutants, *Economic impact, *Chlorination, Drinking water, Public waters, Cost, Government supports, *Cost analysis, Cost-benefit analysis, Water sampling, Groundwater, Treated water, Surface water.

Trihalomethanes (THMs) have been associated with human cancer and genetic defects in tests conducted by the U.S. Environmental Protection Agency. Proposed changes to Chapter 6 of the Illinois Public Water Supply Regulations contained in regulatory proposal R81-11 seek to control THM concentrations in Illinois' public drinking water. The EPA has set a maximum contaminant level of 0.10 mg/1 for Total THMs; all Illinois public water supplies (PWS) serving more than 75,000 people must try to comply by November 5, 1981 and those serving 10,000-75,000 just approach compliance by November 5, 1983. Most (85%) of Illinois' water comes from groundwater sources and Lake Michigan, which historically have had negligible levels of TTHM. Forty-three PWS serve more than 10,000 people. Typical surface water treatments are coagulation, filtration and chlorination. Groundwater must also be chlorinated. Many PWS can lower their TTHM levels by changing chlorination points and/or replacing chlorine with another disinfectant. Estimating compliance costs is difficult for lack of statewide sampling results. TTHM sampling done in private labs will cost the PWS $45/sample vs. $22.50/sample in state labs. For 1200 samples the first year, adopting the proposal would save $27,000, and $9,622.50 a year therafter for 428 samples. Illinois would also continue receiving $1.2 million in federal funding. Economic impacts on agriculture and commerce would be negligible; the chemical industry might see minor increases. The incremental benefits of adopting the measure outweigh the costs by the $1.2 million in federal assistance plus any difference in analytical cost. (Atkins-Omniplan)
W82-06098

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer, J. J. Barry, III, G. M. Palen, and A. E. Scrivner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243734, Price codes: A07 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report UNC-WRRI-82-179, April

1982. 127 p, 26 Fig, 31 Tab, 48 Ref, 1 Append. OWRT B-126-NC(1), 14-34-0001-9035.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Carcinogens, *Drinking water, Water treatment, Urban areas, Chlorine, Wastewater treatment, Gas chromatogaphy, Potable water, Water quality control, Water quality, Chemical treatment, Water treatment facilities, Impaired water quality, Water analysis, Chemical analysis, Chemical reactions, *North Carolina, *Trihalomethane, Pollutant identification.

Analyses for trihalomethanes (THMs) in drinking water (by gas chromatography with electrolytic conductivity detection) showed that they are formed during water treatment in nine of the larger cities in North Carolina. Furthermore, concentrations of these suspect carcinogens often exceeded the established maximum contaminant level at three of these locations. Examination of potential surrogate measures of THMs suggests that ultraviolet/absorbance and total organic carbon are good indicators of THMs and their precursors. Statistical analysis of the data was ued to identify seasonal variations, temperature effects, geographical trends, and other water quality characteristics and water treatment practices which contribute to THM formation. A standardized THM formation potential method was found particularly useful in this regard. Chlorination/coagulation practices at a Wilmington water treatment plant were studied in an attempt to assess approaches to THM reduction; it was found that THM concentrations in finished water could be substantially reduced by shifting the point of initial chlorine application to a point following sedimentation. Similar results were obtained on a laboratory scale for Chapel Hill and Raleigh waters. (Zielinski-MAXIMA)
W82-06158

APPROPRIATE SELECTION OF WATER/WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,
Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
For primary bibliographic entry see Field 5D.
W82-06162

INVESTIGATION OF THE CHEMICAL NATURE AND POSSIBLE TOXICITY OF PRODUCTS FORMED DURING THE OZONE DISINFECTION OF DRINKING WATER CONTAINING ORGANIC SUBSTANCES,
Auburn Univ., AL. Dept. of Chemistry.
W. C. Neely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254970, Price codes: A02 in paper copy, A01 in microfiche. Report, January 1981. 18 p, 3 Fig, 2 Tab, 18 Ref. OWRT A-070-ALA(1), 14-34-0001-0101.

Descriptors: *Ozonation, *Drinking water, *Chemical reactions, *Chemical analysis, *Carcinogens, Ozone, *Water treatment, Potable water, Chemical properties, Oxidation, Organic compounds, Phenols, Industrial wastes, Catalysts, Toxicity, Hazardous materials, Pollutants, Pollution sources.

The potential for formation of carcinogenic epoxides of polycyclic aromatic hydrocarbons (3,4-benzopyrene and napthalene) in drinking water through action of ozone on their dissolved or suspended forms was explored. Within the limits of the techniques used, no conclusive evidence for epoxide formation from either compound was found; Ames bioassay produced no evidence for existence of their mutagenicity following ozone treatment. In addition, the ozonization of a model organic (phenol) in aqueous solution was studied using two approaches (ultraviolet (UV) light irradiation, and metal ion catalysts) for accelerating the rate of ozonolysis in aqueous solution. It was concluded that UV-induced ozone decomposition is responsible for photo-assisted ozonization, allowing for direct calculation of the light intensity needed to obtain a given degree of accelerated ozonization under specified conditions. Testing the catalytic ability of 25 transition metals and lanthanides revealed that vanadium pentoxide, uranium dioxide, and cobalt(II) catalyzed ozone decomposition, with the latter effectively tested for phenol ozonization. The results all indicate that aqueous phenol ozonization proceeds through initial ozone decomposition to a reactive species, for which the hydroxyl radical is proposed; this is in distinct contrast to established mechanisms in nonaqueous solution. (Zielinski-MAXIMA)
W82-06173

SUPPLYING WATER TO THE RURAL COMMUNITY,
DeWild Grant Reckert and Associates Co., Rock Rapids, IA.
M. Whye, and D. Holman.
Public Works, Vol 113, No 5, p 58-60, May, 1982. 1 Fig, 1 Tab.

Descriptors: *Rural areas, *Water supply, Water distribution, Water treatment, Lincoln-Pipestone Rural Water System, *Minnesota, Pipelines, Water quality.

The Lincoln-Pipesteon Rural Water System, southwest Monnesota, is an example of a modern rural water system. It serves 900 customers in 11 communitites spread over a 70 x 25 mile area. After a feasibility study, funding was arranges ($4 milliongrant and $6.4 million loan). The completed system obtains its water from four 60-70-ft deep gravel packed wells of 400-450 gpm capacity each, fieed with submersible pumps. Water is of good quality, requiring only chlorination and fluoridation. Water is delivered by sin pumping stations/groundwater storage reservoirs with combined storage capacity of 1.1 million gallons. Outlying stations are served by four high pressure pumps. The major construction cost was the distribution system, 645 miles of main pies and 70 miles of service pipes. Billing is done according to meter reading supplies monthly by the users. Aneffective rural water system must, first of all, have enough subscribers to justify costs. Second, water must be affordable. Consumers in a rural water system have good qualtiy, reliable water for hone and livestock use. However, fire protection and irrigation water are not generally provided. (Cassar-FRC)
W82-06223

OVERHAULING A WATER SYSTEM,
Kupper (Charles J.), Inc., Piscataway, NJ.
C. H. Witte.
Public Works, Vol 113, No 5, p 74-75, May, 1982.

Descriptors: *Water distribution, *Rehabilitation, *Water treatment, Water supply, Water mains, Water storage, Tuckerton, *New Jersey, Water metering.

Water problems in Tuckerton, New Jersey, led to the acquisition of the Tuckerton Water Company by the borough municipal utilities authority. The town of 2412 year-round population and 8000 peak summer population had an antiquated distribution system, an inoperable treatment facility, and an undersized, deteriorated storage tank. Estimated costs of improvements were $2.8 million, for which financing was obtained by a loan and a grant. Renovation of the system began with the water treatment facility, in which the old filter was repaired and a new one added and new pumping and feed equipment installed. A 6 inch water main was constructed to loop the system and stabilize the pressure. A 12 inch ductile iron main replaced a 4 inch concrete main. Other improvements were an additional supply well, a 1.4 million gallon storage standpipe, replacement of 60% of the distribution system, and installation of water meters. Future work includes more improvements to the water treatment plant. (Cassar-FRC)
W82-06224

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,
Technicon Instruments Co. Ltd. (England).
D. G. Thomson.
Water Pollution Control, Vol 81 No 2, p 193-199, 1982. 2 Fig, 7 Ref.

Descriptors: *Data processing, *Microprocessors, Automation, Computers, Laboratories, Research facilities, Equipment.

In the early 1970s computer controlled water treatment plants appeared as the fist sign of revolutionary changes in the water industry in the United Kingdom. This first step towards automation of water analysis provided a solution to the problem of coping with large sample numbers, but it has since become apparent that the computation of the data which all forms of instrumentation produce is now a major problem. The fast handling of samples is meaningless if the information gained from the analyses cannot be managed efficiently. The most recent approach to such problems is the use of microprocessing equipment. The use of such equipment in an attempt to improve the performance of the analytical instrument and to increase the degree of automation involved consideration of the following features as basic in the design: flexibility in routine operation, total automation of the autoanalyzer, validation of data, direct interfacing to existing systems, and improvement in the chemical performance. The LDM system is described; it includes a SEMS solar computer which is modular and can be upgraded as the workload or organization changes. (Baker-FRC)
W82-06259

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,
Turbitrol Co., Atlanta, GA.
For primary bibliographic entry see Field 5D.
W82-06263

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06265

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,
Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
L. Fiksdal, E. A. Vik, A. Mills, and J. T. Staley.
Journal of the American Water Works Association, Vol 74, No 6, p 313-318, June, 1982. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Drinking water, *Bacteria, Water treatment, Potable water, Chlorination, Temperature effects, Disinfection, Pollutant identification.

In order to determine the optimum conditions for maximizing viable counts of bacteria from drinking water samples, various enumeration procedures were examined. Nonstandard procedures which increased bacterial count included: media that were more dilute than Standard Methods Agar, incubation periods that ranged from 2 to 13 or 14 days and longer, and an incubation temperature of 20 degrees C. The differences between the results obtained with these nonstandard methods suggests that there may be regional differences in bacterial flora which account for the differences in efficacy of enumeration procedures. Additionally, strain diversity was estimated for heterotrophic bacteria from nonchlorinated and chorinated waters. In this examination, untreated source waters had a greater diversity of bacteria than did chlorinated samples. This suggests that chlorination allows few species to survive in distribution systems. (Baker-FRC)
W82-06278

ADVANCED WATER TREATMENT FOR COLOR AND ORGANICS REMOVAL,
Dillon (M. M.) Ltd., London (Ontario).
T. A. Constantine.
Journal of the American Water Works Association, Vol 74, No 6, p 310-313, June, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Water treatment, *Drinking water, Potable water, Chlorination, Disinfection, Ozona-

tion, Activated carbon, Color removal, Humic acids, *Filtration, *Biological activated filtration.

This paper discusses and evaluates a relatively new process called biological activated filtration (BAF) in comparison to the conventional physical-chemical process that traditionally has been used to remove color and organic compounds from drinking water supplies. The BAF process can offer reduced capital and operating costs lower chemical dosage requirements, and lessen sludge-disposal problems for treatment of highly colored waters than conventional treatment programs. BAF processes would suit commonly occurring raw water conditions, and consist of the following steps: ozonation - carried out in gravity flow through contact tanks with twenty minutes' detention time after ozone contact, providing for the reaction of the most refractory organic compounds; GAC adsorption carried out in either gravity or pressure vessels, with a 20 minute period in the carbon beds being needed; stabilization via a hydrated lime slurry injected into the treated water from the BAF units to stabilize the corrosive tendency of the water; and postchlorination prior to delivery to the distribution system and storage facilities to ensure that residual concentrations sufficient for disinfection are present in the system up to each user's service. (Baker-FRC)
W82-06279

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, M. A. Meyer, and M. S. Paller.
Journal of the American Water Works Association, Vol 74, No 6, p 322, June, 1982. 1 Fig, 3 Ref.

Descriptors: *Drinking water, Microorganisms, *Standard plate count, Membranes, *Membrane filters, Pollutant identification, Water treatment, Treatment facilities.

In this study the membrane filter Standard Plate Count (m-SPC) procedure was compared with the SPC procedure using samples collected from two New England water treatment plants and distribution systems. Samples at each plant included raw water, partially treated water immediately after post-chlorination, and three samples taken within the distribution system of the plant at various transit times following treatment up to about 1 week. Computerized analyses performed on the data collected indicate that the m-SPC method is a satisfactory alternative to the SPC method. Moreover, the m-SPC method is more sensitive than SPC because it can handle sample volumes in excess of 1.0 mL. However, it is noted that the SPC procedure itself, and thus the m-SPC procedure as well, is imprecise, as it fails to enumerate a sizable portion of potable water organisms, since the choice of incubation time and medium is arbitrary. (Baker-FRC)
W82-06280

GROUNDING OF ELECTRIC CIRCUITS TO WATER SERVICES: ONE UTILITY'S EXPERIENCE,
Suffolk County Water Authority, Oakdale, NY.
A. A. Guerrera.
Journal of the American Water Works Association, Vol 72, No 2, p 82-87, February, 1980. 7 Fig, 11 Ref.

Descriptors: *Electrical grounding, *Pipelines, Equipment, *Electric currents, Water transport, Accidents, Hazards, Safety, Water quality, Sulfides, Copper, Corrosion.

The use of water service pipes for grounding of electric circuits has resulted in numerous and documented cases of deterioration of water quality, increased rates of corrosion of copper plumbing, and potential hazards to water supply personnel. The Suffolk County Water Authority in Oakdale, New York, still has more than 230,000 active services acting as secondary grounding electrodes, despite the availability of effective and approved alternate grounding systems. It has been demonstrated that if two or more electric utility customers are fed from one transformer, and there is a water pipe ground connection for each customer, some current will always flow over the grounding connections under normal conditions. This results in the utilization of water utility piping and its appurtenances for purposes other than those for which it was designed and installed. It has further been demonstrated empirically that corrosion of tubing or deterioration of water quality occurs in areas receiving the same treated water where the only apparent variable is the presence of stray electric currents. In homes where copper corrosion of the pipes has resulted in deterioration of water quality, a recording clamp-on ammeter has been used to determine whether there was current flow between the affected residences and a common transformer and to note the peaks in the current flow. In many cases the problem of copper corrosion disappeared after an insulating coupling was installed on the corporation stop at the main. A poor or damaged ground in one residence has also been shown to affect the flow of electricity and the water quality in a neighboring residence. Changes in taste and odor have also occurred where water containing sulfur was affected by a substantial current flow, with the sulfur reduced to sulfide. (Baker-FRC)
W82-06281

DRINKING WATER DISINFECTION,
Strauss and Roberts, Inc., Porterville, CA.
K. E. Longley, and B. Roberts.
Water/Engineering and Management, Reference Handbook-1982, p 26, 28-30, May, 1982. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Drinking water, *Disinfection, Chlorination, Chlorine dioxide, Ammonia, Chloramines, Ozonation, Water treatment.

The design and selection of a disinfection system requires the development and analysis of treatment objectives together with the economic and operation factors which impact on the optimization of disinfection process. The first step is good engineering practice to be followed in the selection of disinfectants and the subsequent process optimization. Primary and secondary treatment objectives for water of a known quality must be assessed, and then the disinfectant dose to attain the desired objectives must be determined. Ozone is an outstanding disinfectant that has been used extensively in Europe. Ozonation systems may be divided into four sub-systems: oxygen generation or air pretreatment; ozone generation; off-gas ozone destruction; and process control. Chlorination of drinking water is a practice undergoing only slow evolutionary change during the past few decades. Sulfur dioxide is the usual choice for a dechlorinating agent for facilities practicing chlorination. Water treatment plants using hypochlorination typically have a storage area for bulk storage of chemical. The chloramine disinfection process fell into disuse generally due to the superior quality of the water product after using hypochlorous acid. A variant of the chloramine or chlorine-ammonia process is the introduction of ammonia to the water stream after a controlled contact time with free chlorine. An effective disinfectant producing minimal trihalomethanes in the presence of their precursors is chlorine dioxide. Its use is growing for taste and odor control. Disinfectant selection requires evaluation of treatment objectives, including interrelated engineering economic, operation, health and safety considerations. (Baker-FRC)
W82-06341

PROCESSES FOR REMOVAL OF INORGANIC CONTAMINANTS FROM WATER,
Cullen Coll. of Engineering, Houston, TX.
D. Clifford.
In: Water/Engineering and Management, Reference Handbook-1982, p 31-32, 34, 36-38, May, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Water treatment, *Water supply development, Fluorides, Nitrates, Arsenic, Selenium, Reverse osmosis, Potable water, Drinking water, Electrodialysis, Alumina, Resins.

A project has been undertaken to evaluate the single contaminant removal process versus the desalting processes. This project is designed to help small communities which have inorganic contaminant problems. The single contaminant removal processes available for the engineer to chose from include alumina adsorption or ion exchange. The desalting processes include reverse osmosis or electrodialysis. To make the proper choice both technically and economically, consideration must be given to the raw water total dissolved solids level, speciation of contaminant, concentration of ions competing for adsorption or ion exchange sites, silt density index, public health risk in event of process failure or contaminant breakthrough, quality of water required for distribution, and buffer capacity to be overcome for pH adjustment. In order to design an effective process the fundamentals must be understood particularly in relation to selectivity sequence, percent contaminant passage expected, and pretreatment, post treatment and waste disposal requirements. (Baker-FRC)
W82-06342

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,
Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W82-06348

POTABLE WATER TREATMENT BY DISSOLVED AIR FLOTATION AND FILTRATION,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Journal of the American Water Works Association, Vol 74, No 6, p 305-310, June, 1982. 3 Fig, 7 Tab, 16 Ref.

Descriptors: *Potable water, *Water treatment, Domestic water, Drinking water, Disinfection, *Flotation, Filtration, *Dissolved air flotation.

This report discusses bench and pilot plant tests of a potable water treatment system consisting of chemical feeding, dissolved air flotation, gravity filtration, and disinfection. The report describes the conceptual design of the purification system, a technical feasibility study, an economic feasibility study and recommendation for future research. The system was proposed for the city of Pittsfield, 60,000 inhabitants, located in the Berkshire Hills of western Massachusetts. The water sources consist of three surface reservoirs supplying about 56 ML/day to the city and communities surrounding it. The system emphasizes the use of a dissolved air flotation (DAF) unit for water purification. Carbon absorption is proposed for removing toxic organic substances. Successful treatment of Pittsfield raw water was obtained by this system. The total annual costs for the proposed system are estimated to be $233,708, $846,888 and $4,551,998 for plants with flow rates at 3.7, 37, and 370 ML/day, respectively, which are lower than costs of a conventional system. (Baker-FRC)
W82-06353

BIOCLEANSING WITH AQUATIC WEEDS: A MEANS OF REMOVING ASBESTIFORM FIBERS FROM WATER,
Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256579, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report No 712431, December, 1980. 14 p, 1 Fig, 19 Ref. OWRT A-057-OHIO(1).

Descriptors: *Asbestos, *Drinking water, *Aquatic plants, *Electron microscopy, *Water quality control, *Elodea, Municipal water, Aquatic life, Submerged plants, Reservoirs, Potable water, Microscopy, Water supply, Reservoir operation, Quality control, Adsorption, Water storage, Water use, Water treatment.

Research was conducted to find a suitable aquatic plant for the removal of asbestos from municipal water supplies. Aquatic plants were grown in 35 and 200 liter aquaria and exposed to known concentrations of equal parts of chrysotile and tremolite asbestos with water circulation provided by air stones. Water samples and thin plant sections were taken for asbestos analysis by electron microscopy. All plant types removed asbestos fibers to some degree, with elodea removing the greatest number per gram of plant material. Data were also obtained for pondweed, scirpus, and sagittaria. The amount of asbestos fibers removed was directly proportional to the surface area of the plant. Analysis revealed that the fibers accumulate externally on the plant surface, possibly through an electrochemical reaction. Elodea, with its many leaves, has a far greater surface area than other plants tested and also has the greater rate of growth. The study results suggest that plants should be left in reservoirs to scavenge asbestos fibers. Further study should be directed towards the use of plants in outdoor holding ponds to assess their efficacy for eliminating asbestos from drinking water at relatively low costs. (Zielinski-MAXIMA)
W82-06363

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W82-06398

GETTING YOUR MONEY'S WORTH FROM FILTRATION,
Environmental Protection Agency, Cincinnati, OH.
G. S. Logsdon, and K. Fox.
Journal of the American Water Works Association, Vol 74, No 5, p 249-256, May, 1982. 15 Fig, 2 Tab, 36 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Filter media, *Diatomaceous earth, Protozoa, Bacteria, Asbestos, Coagulation, Flocculation, Sedimentation, Backwash, Viruses, Giardia, Sand filters, Coliforms, Reviews.

Effective operation of diatomaceous earth (DE), slow sand, and rapid granular media water filtration plants is described. Among the particles which must be removed by filtration are asbestos, bacteria, clay, protozoan cysts, fine rock particles, and viruses. In DE filtration small quantities of DE as a filter aid are continuously added to the feed. Filtration takes place on a permeable septum precoated with a thin layer of DE. Coagulants are rarely used. DE filtration may be done under pressure or vacuum. Removal of Giardia cysts can reach 99.99%; asbestos fibers, 99.99%; and plankton, 100%. Turbidities of 0.10 NTU are attainable. The granular media filtration process, most commonly used in the U.S., usually includes coagulation, flocculation, sedimentation, and filtration. If raw water quality is good, sedimentation and sometimes flocculation may be omitted. Continuous monitoring of turbidity can quickly detect early filter breakthrough. Filters should be backwashed before turbidity reaches the 1 NTU level. Giardia cysts and asbestos fibers removal is effective when turbidities do not exceed 0.1 NTU. Slow sand filtration, a biological process developed in the 19th century, effectively removes bacteria. The system is most suitable for small communities because capital costs are low and large areas of land are required for the filter beds. (Cassar-FRC)
W82-06412

WATER SUPPLY AND DISTRIBUTION IN LARGER COMMUNITIES,
R. A. Pavia.
Journal of the American Water Works Association, Vol 74, No 5, p 20, May, 1982. 1 Ref.

Descriptors: *Financing, *Water treatment facilities, *Public utility districts, Chicago, Water supply, *Water distribution, Capital costs, Utilities, Rehabilitation, *Urban areas.

Water systems and other public utilities face financing crises as physical facilities age, costs increase, and consumers resist rate increases. The Chicago, Illinois, water system's financial condition is described as an example of a utility serving a large community. Although the city's allowance of $18.7 million per year for capital improvements appears to be far short of the ideal $30-50 million per year other factors must be considered. Replacement of small water mains is being delayed because redevelopment plans for some areas are not yet known. The two water purification plants (built in 1947 and 1964) are in good condition and have excess capacity for new customers. Future customers will pay the costs of extending the distribution system. Therefore, the utility expects to make a $8 million per year profit from new service by 1985. Much of this revenue will be available for capital improvements. The city is now benefiting from building a system larger than was needed at the time of construction. (Cassar-FRC)
W82-06413

ENERGY-INPUT-CONTROLLED DIRECT FILTRATION TO CONTROL PROGRESSIVE EUTROPHICATION,
Wahnbachtalsperenverband, Siegburg (Germany, F.R.).
H. Bernhardt, and H. Schell.
Journal of the American Water Works Association, Vol 74, No 5, p 261-268, May, 1982. 11 Fig, 5 Tab, 32 Ref.

Descriptors: *Eutrophied lakes, *Phosphorus removal, *Filtration, Reservoirs, Water treatment, Algae, Flocculation, Wahnbach Reservoir, West Germany, *Direct filtration, West Germany, Wahnbach Reservoir.

Phosphorus input to the Wahnbach Reservoir, near Bonn, West Germany, has been reduced since 1977 by an energy-input-controlled direct filtration process. The phosphorus elimination plant, located on the reservoir's main tributary, pumps water from a prereservoir and precipitates the dissolved phosphate with 4-10 mg per liter ferric salts. The colloidal iron compounds are destabilized by mixing during a 20 sec period. Further mixing in the agglomeration basins develops flocs large enough to filter easily. The filter medium is composed of granular activated carbon on the top, hydroanthracite in the middle, and fine sand on the bottom. Particle size decreases from 3-5 mm in the top layer to 0.7-1.2 mm in the bottom layer. The total filter area of 1200 sq m treats 432 ML per day. Removal efficiencies are: total P, 96.3%; total coliforms, 99.87%; total plate counts, 97.9%; chlorophyll, 94.9; turbidity, 99.3%; COD, 77%; dissolved organic carbon, 57.8%. Effluent water contains $<$ 10 micrograms per liter P. The trophic state of the reservoir has changed for eutrophic to mesotrophic since the phosphorus elimination plant was put into operation. Secchi depth has increased from 3 to 6 m. Species composition of algae has changed. Blue-green algae have completely disappeared, and Chlorella are present only in small quantities. (Cassar-FRC)
W82-06414

THE EFFECT OF BACKWASHING RATE ON FILTER PERFORMANCE,
Minneapolis Water Works, MN.
N. Qureshi.
Journal of the American Water Works Association, Vol 74, No 5, p 242-248, May, 1982. 8 Fig, 3 Tab, 15 Ref.

Descriptors: *Filtration, *Backwash, *Fluidized beds, Turbidity, *Water treatment, Minneapolis, Minnesota, Head loss, Filter media, Dual media filters, Mixed media filters.

Backwashing at fluidization rates (11.8 mm per sec) and subfluidization rates (8.4 mm per sec) was conducted on a plant scale in Minneapolis' Fridley water filtration plant using identical pairs of mixed media (coal, sand, ilmenite) and identical pairs of dual media (coal, sand). The plant treats Mississippi River water with lime softening followed by alum coagulation and filtration. At both backwashing rates the mixed media filters had higher turbidity during the first half hour of the runs. The low backwashing rate produced a higher turbidity peak than the high rate. After an hour into the run turbidity gradually decreased to a low at about 20 hours, then gradually increased until the end of the run at 70 hours. Head losses were similar for low and high backwashing rates in the mixed media filters. In the dual media filters turbidity peaks were also reached during the first hour, higher turbidity being produced by the low backwashing rate. At both backwashing rates turbidity leveled off at about 10 hours and remained constant until 50 hours, when it gradually increased to the end of the run, about 62 hours. Head losses were consistently higher in the low rate dual media filter than in the high rate dual media filter. Two peaks of turbidity were evident during the early stages of filter runs, the first and small peak about 1 min after the start of the run and the second and larger peak at about 10 min. Methods of handling the initial stage of turbidity include wasting the poor quality effluent or use of polymer during backwashing. Lower backwashing rates save energy and permit use of smaller tank and piping sizes. However, filter runs are somewhat shorter. No mudball formation was observed during use of low backwashing rates. (Cassar-FRC)
W82-06415

LOW-DOSAGE HIGH-RATE DIRECT FILTRATION,
Water and Air Research, Inc., Gainesville, FL.
E. G. Wagner, and H. E. Hudson, Jr.
Journal of the American Water Works Association, Vol 74, No 5, p 256-261, May, 1982. 7 Tab, 20 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, Pilot tests, Reviews, Alum, Coagulation.

The advantages of low-dosage direct filtration water treatment are emphasized in a review of the author's experiences and a review of the literature. Direct filtration is an economical process, saving costs by reduced chemical consumption, reduced single sludge load, and lower initial capital costs. Generally, in the U.S. the raw water treated by direct filtration should not have more than 15 platinum cobalt method color units and 1 NTU turbidity. Jar tests can determine the minimum doses of coagulant and polymers. Plants operating in the conventional mode can use direct filtration part-time. Pilot plant tests in several locations are described. In a California plant larger-scale tests used consistently less polymer dosage and filters performed better than the bench-scale tests indicated. Tests in Guam; Brasilia, Brazil; and Amman, Jordan, were carried out during periods of high turbidity. With proper choice of chemical dosage, filter media, and in one case, prsettlement of solids, turbidities of $<$ 1 NTU were obtained at relatively high filter rates. In several West African countries, the high cost of alum makes low-dosage direct filtration attractive. Laboratory tests on water from these regions indicate that water of turbidity $<$ 5 NTU (World Health limit) can be produced by direct filtration. The literature describes many more cases of low-dosage filtration, suggesting that this process is becoming increasingly accepted throughout the world. (Cassar-FRC)
W82-06416

LOW COST FILTRATION PLANTS FOR WATER SUPPLY OF ARDHA-KUMBHA MELA, 1980 AT HARDWAR,
J. P. Nigam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 117-118, June, 1981. 1 Fig.

Descriptors: *Drinking water, *India, *Water supply development, *Filters, *River beds, Ganges River, Potable water, *Water treatment, Coliforms, Water quality control, Chlorination, Turbidity, Suspended solids, Filtration, Sand filters, Percolating filters.

To supply drinking water to the pilgrims attending the Ardha-Kumbha Mela of 1980 at Hardware, a

low cost filter unit was installed below the Ganges River near Bijnor. The filter unit uses the river bed itself as the filter media, eliminating the need for chemicals and backwashing. The unit is connected to a pump and pipeline and a chlorination device. Comparisons of raw and filtered water showed reductions in turbidity from 75 to 2 ppm and complete elimination of coliforms. Suspended matter was removed down to 0.1 microns. The manufacturing and installation costs of this filter unit are very small and its installation is much easier in comparison with pressure filters. Once installed, the unit may be used for years without complications. (Geiger-FRC)
W82-06437

EVOLVING HIGH RATE FILTER AND USE OF CRUSHED STONE AS FILTER MEDIA,
Madhya Pradesh State Planning Board, Bhopal (India).
D. R. J. Rao.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 92-96, February, 1981. 4 Tab.

Descriptors: *Filter media, *Filtration, *Water treatment, Sand filters, Crushed stone, Rapid flow, Gravity filters, India, Laxim Narain Giri.

Selected local crushed stone filter media and sand were used in high rate filtration for over a year at the Laxmi Narain Giri water treatment plant in India. These local materials were tested as substitutes for the commonly used anthracite coal, unabailable in India. Crushed stone effective sizes were 0.4-0.7 mm, and sand effective sizes were 0.45-.7 mm. Average removal of turbidity was 76.7% in sand and 80.44% in crushed stone at a filtration rate of 80 lpm per sq m; 77.18% in sand and 87.60% in crushed stone at a filtration rate of 160 lpm per sq m. Average removal of bacteria was 69.5% in sand and 97.07% in crushed stone at a filtration rate of 80 lpm per sq m; 92.2% in sand and 95.45% in crushed stone at a filtration rate of 160 lpm per sq m. (Cassar-FRC)
W82-06440

SETTLING CHARACTERISTICS OF FLOCCULENT SUSPENSION IN DEFLUORIDATION OF WATER BY NALGONDA TECHNIQUE,
National Environmental Engineering Research Inst., Nagpur (India).
W. G. Nawlakhe, B. N. Pathak, K. R. Bulusu, and R. Paramasivam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 85-88, February, 1981. 1 Fig, 5 Tab, 4 Ref.

Descriptors: *Settling basins, *Flocculation, *Fluorides, Turbidity, Suspended solids, Design criteria, *Nalgonda technique, *Water treatment, Settling velocity, *Defluoridation.

The Nalgonda technique, which removes excess floride from drinking water, comprises addition in sequence of sodium aluminate or lime, bleaching powder and filter alum, followed by flocculation sedimentation, and filtration. Batch laboratory settling column tests (200 cm x 30 cm diameter) using this procedure were run to obtain information for designing settling basins. A curve of percentage suspended solids removal vs. surface overflow rate (SOR) was prepared. For example, for 90% removal of suspended solids the SOR was 75 cu m per sq m per day; for 60% removal, 105 cu m per sq m per day. For application to an actual design, a factor of 1.50-2.00 should be applied to compensate for the differences between theoretical and actual behavior. A factor of 2.0 would change the above SOR to 37.5 cu m per sq m per day and 52.5 cu m per sq m per day, respectively. (Cassar-FRC)
W82-06441

PRESEDIMENTATION TANKS FOR HIGH TURBID RAW WATER,
H. A. Sabannavar.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 67-74, February, 1981. 9 Fig, 3 Tab.

Descriptors: *Suspended solids, *Industrial water, *Settling tanks, *Water treatment, Sand, Turbidity, Ganges River, India, Pumping plants, Damage, Sedimentation.

Two presedimentation tanks were designed to eliminate difficulties experienced in the water treatment plant of the Antibiotics Plant, Virbhadra, India. Suspended solids concentrations in the Ganges River, the source of the raw water, reached 36,000 mg per liter during abnormal flooding and 5,000-10,000 mg per liter during normal monsoon flooding. The treatment plant was designed for a maximum of 3,000 mg per liter turbidity. Some of the problems caused by this extreme turbidity were pump and scraper damage, choking of pipes and filter beds, deposition of sand in the intake well, and frequent shutdowns for cleaning. Several modifications had been attempted--changing the course of the river, altering the bank projections, taking in water from the surface, water jets to keep sand suspended in the pump system, and additional pumps. These changes reduced sand deposits to some extent. The presedimentation system consisted of the two 37.5 x 61.5 m tanks, a pump house with four centrifugal pumps, a rising main, a 2.5 x 2.5 x 2.7 m main tank which acted as a stilling chamber, and a sludge gate. The tanks, of which one can serve as a standby, removed 78%-84% of suspended solids from 3.2-3.5 million cu m of water during a 45 day test in 1975. Suspended solids in the raw water were 200-3975 mg per liter, and total sand-silt deposits in the two tanks were 4029 and 6631 cu m, respectively. Turbidity removals averaged 10%. During an abnormal 31,000 mg per liter suspended solids period in 1976, the tanks functioned at 85% efficiency for suspended solids removal. (Cassar-FRC)
W82-06444

MEMBRANE SEPARATION PROCESSES,
Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W82-06445

M B SETTLER: A MORE ECONOMICAL ALTERNATIVE TO CONVENTIONAL SETTLER,
A. S. Gupta, and S. V. Patwardhan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 62-66, February, 1981. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Settling tanks, *Turbidity, Tube settlers, Sludge solids, *Water treatment, Wastewater treatment, Multibottom settling tanks, Bacteria, Flocculation, Design criteria, Developing countries, Rural areas, Economic aspects.

A multibottom settling tank (MBST) was developed and tested as a simple and economic water treatment option for rural and small communities. The 3 cu m pilot plant MBST consisted of four clearly divided zones: inlet, settling, outlet, and sludge. The settling zone was made of four units. Each unit consisted of 15 inclined plates. The plant performed as well as a conventional treatment plant at a flow depth of 50 cm or greater, an angle of inclination of 45 degrees, horizontal velocity of 12 cm per sec. surface loading of 6.66 liters per sq m per min, and detention time of 15 min. Total depth of flow, long runs, or shock loading had no significant effect on turbidity removal efficiency. Residual turbidity increased with increasing angle of inclination of the plates, with increases of horizontal velocity above 10 cm per min, and with increases in surface loading. Combining the MBST with a solid media flocculator containing hard coke produced bacterial removals of 83-96% (MPN test). The combined unit requires little electricity or skilled labor. Costs are 67-89% less than for a clarifloculator. (Cassar-FRC)
W82-06446

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,
University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
K. R. Stimson, and A. Brameller.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 154-157, March, 1982. 2 Fig, 1 Ref.

Descriptors: *Network design, *Water distribution, *Computer programs, Simulation analysis.

An interactive graphical computer program, a version of the WATNET program, for network analysis of a water distribution system is described. This offers an improvement over the batch process, which requires a significant amount of work before and after computer processing. The graphical program, written in FORTRAN, may be used for network design, reinforcement, simulation, contingency planning, operation, and loss minimization. (Cassar-FRC)
W82-06453

THE PRODUCTION OF PUBLIC SUPPLY DRINKING WATER FROM RUTLAND WATER AT THE WING TREATMENT WORKS,
Anglian Water Authority, Northampton (England). Pitsford Lab.
D. B. Ford, B. E. Drage, and T. J. Roberts.
Hydrobiologia, Vol 88, No 1-2, p 103-116, March, 1982. 1 Tab, 6 Fig, 1 Ref.

Descriptors: *Reservoirs, *Water supply, *Drinking water, *Water treatment, *Water storage, Water quality, Potable water, Reservoir storage, Water treatment facilities, Chemical treatment, Haloforms, Bacteria, Sludge, Chlorine, Water quality data, Rutland Water, England.

Water is taken from Rutland Water for treatment to potable standards at the Wing Water Works. Since the Wing Water Works opened in 1977, chemical and bacteriological samples of the component waters of the reservoir have been analzyed. In general, turbidity, color, and residual iron have all been low with a high degree of consistency following treatment. Nitrate and sulfate were both fairly high when the reservoir was first filled, but they have steadily declined. Trace quantities of haloforms are produced in the treatment process at Wing. The predominant one is dichlorobromethane; chloroform and dibromochloromethane are also produced at lower and roughly similar concentrations. Although no formal limit exists, a tentative guide level of 100 micrograms per liter for total haloforms has been suggested. (Titus-FRC)
W82-06474

CIRCULATION PATTERNS; THEIR INVESTIGATION AND PREDICTION,
Leicester Polytechnic (England). School of Life Sciences.
E. J. Myers, R. S. Oldham, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 67-77, March, 1982. 1 Tab, 7 Fig, 7 Ref.

Descriptors: *Wind, *Currents, *Algae, *Model studies, Water treatment, England, Reservoirs, Water supply, Water quality, Algal growth, Algal control, Eutrophication, Rivers, Biomass, Primary productivity, Wind-driven currents, Rutland Water.

The effect of wind on the water currents in Rutland Water is being studied with a view to predicting algal distribution patterns so that, by exercising different abstraction options, water treatment problems can be avoided. Investigations using a physical scale model of the reservoir in a wind tunnel suggest that under most wind directions the circulations tend to separate the water body into three distinct topographic regions. Water currents in the reservoir itself have been plotted by tracking the paths of drogues using theodolites. This has indicated that in the central basin the circulation may be of the 'conveyor belt' type rather than the solely horizontal type of the model. Surface chlorophyll readings are shown to indicate wind-driven water currents. Algal distribution has been predicted from wind data; however, the analysis requires modification in order to apply to all wind conditions. Wind will mix surface blooms of algae into deeper water. Strong winds acting on water with weak or non-existent stratification can cause

mixing throughout the whole depth of the reservoir so that abstracting from depth to avoid surface blooms is not feasible. However, provided there is strong stratification, this mixing may only occur within the upper layer of water, in which case water abstracted from below the thermocline will have a reduced algal content. (Titus-FRC)
W82-06477

OPTIMUM USE OF CHLORINE IN CIRCULATING WATER,
Indianapolis Power and Light Co., IN.
G. Brown, and C. McCloskey.
Industrial Wastes, Vol 28, No 3, p 24-26, May/June, 1982. 3 Fig.

Descriptors: *Electric powerplants, *Cost analysis, *Fouling, *Condensers, *Chlorine, Biocides, Chlorination, Electrical equipment, Slime, Cooling water, Operating costs, *Water treatment, Industrial water.

The H. T. Pritchard power station, which provides electrical power during periods of peak usage for the Indianapolis Power & Light (IPL) Company, is cooled by once-through river water and often experiences biological fouling of the condensers. In 1974, a program was started to optimize the use of chlorine (used to control biological fouling) to reduce operating costs and maintain chlorine discharge levels within the range of anticipated future standards. The Pritchard facility is located downstream from the discharge of the Indianapolis sewage treatment plant, which contributed tremendously to biofouling and loss of generation efficiency, especially during summer months. Studies to optimize chlorine use involved the testing of chlorine enhancer to help the biocide penetrate the fibrous slime masses generated by microorganisms. Comparison of turbine generator units with and without the penetrator showed a faster development of slime after chlorine use without the penetrating agent. Tests were conducted in 1979 to optimize the feed rate of the penetrating agent and the plant's operations in warmer weather. Experiments in 1980 used a small sidestream condenser as a control unit from which to extrapolate chlorination rates for the larger IPL units. Cost savings as a result of these efforts amount to $6,250 annually. (Geiger-FRC)
W82-06498

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,
Metcalf and Eddy. Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06511

INFLUENCE OF STABILIZER CONCENTRATION ON EFFECTIVENESS OF CHLORINE AS AN ALGICIDE,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
M. R. Sommerfeld, and R. P. Adamson.
Applied And Environmental Microbiology, Vol 43, No 2, p 497-499, February, 1982. 3 Fig, 7 Ref.

Descriptors: *Algicides, *Chlorine, Toxicity, Swimming pools, *Water treatment, Chemical treatment, Chlorination, *Cyanuric acid.

Cyanuric acid or the compounds of chlorinated cyanurates are frequently used in swimming pools to reduce the loss of free chlorine by ultraviolet radiation. Several studies have investigated the influence of cyanuric acid on the bactericidal efficiency of chlorine; however, the effect of this stabilizer on the algicidal efficiency of chlorine has not been studied. This investigation showed that cyanuric acid has a relatively minor effect on the algicidal efficiency of free chlorine. When inhibiting, but less than algicidal, concentrations of chlorine were used, the addition of 25 milligrams of cyanuric acid per liter slightly reduced the toxicity of free chlorine to three swimming pool algae. Higher stabilization concentratins, ranging from 50 to 200 milligrams per liter, generally resulted in no further reduction in the algicidal efficiency of free chlorine. (Carroll-FRC)
W82-06539

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W82-06543

FACTORS THAT AFFECT USE OF DIRECT FILTRATION IN TREATING SURFACE WATERS,
West Virginia Inst. of Tech., Montgomery. Dept. of Civil Engineering.
R. F. McCormick, and P. H. King.
Journal of the American Water Works Association, Vol 74, No 5, p 234-242, May, 1982. 5 Fig, 5 Tab, 29 Ref, OWRT A-081-VA.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, *Virginia, Surface water, Alum, Coagulation, Polymers, Filter media, Color removal, Algae, Bacteria.

Surface waters from five locations in Virginia were treated by direct filtration in a pilot plant. Raw water quality was variable: 1.2-24 NTU turbidity, 0-42 APHA color units, 40-20,000 algal colonies per ml, 0-2300 per 100 ml total coliforms, and 1.5-13.5 C temperatures. The most effective treatment was a 3 minute rapid mix with alum and a cationic polymer. Filtration at 3.5 mm per sec through 51 cm of 1.3 mm anthracite coal and 25 cm of 0.45 mm silica sand was more effective than the other two filters tested--a mixed media filter of coal, sand, and garnet, and a dual coal-sand filter with 1.7 mm size coal. The filtered water met the 0.1 NTU standard if raw water characteristics were within the following ranges: turbidity, 0-10 NTU; color, 0-15 APHA units; algae, 0-1000 clumps per ml. Water with high individual parameters was succesfully treated if the other parameter values were low. Runs made at temperatures of 4 and 6 C were satisfactory, indicating that low temperatures did not adversely affect the filtration process. (Cassar-FRC)
W82-06579

METAL REMOVAL 'A LA CARTE',
J. C. Ginnocchio.
World Water, Vol 5, No 5, p 30, 32-33, May, 1982. 8 Fig, 1 Tab.

Descriptors: *Metals, *Flocculation, *Water treatment, *Wastewater treatment, Heavy metals, Iron, Manganese, Silver, Arsenic, Barium, Cadmium, Chromium, Copper, Mercury, Selenium, Lead, Zinc, Industrial wastewater, Alumina, Activated carbon, Trace metals, Chemical precipitation, Sedimentation, Filtration, Hydrogen ion concentration, Adsorption.

Methods of removing undesirable trace metals from drinking water are described. Fe and Mn levels are reduced by aerating the water and filtering the precipitated, oxidized metals. Fe-humic complexes may be removed by flocculation-filtration. Flocculation-sedimentation can be used to remove Ag, As(5+), Ba, Cd, Cr(3+), Cu, Hg, Se(4+), Ni, Pb, and Zn. The process is pH-dependent. Removals at pH 6.5-7.0 using 5 mg per liter of trivalent iron are 90% for Pb, As(5+), and Cr(3+), almost zero for Ba and Cr(6+), and 24%-78% for the other metals. A pH of 7.5-8.5 and the same flocculant dose improves Ag, Cd, and Hg removal but decreases Se(4+) removal. Ba and Cr(6+) are not affected. Addition of ferrous sulfate, however, removes 95% of Cr(6+). A pH of 10.0-10.5 separates most of the metallic ions in sloped tube settlers. Cr(6+) and Se(4+) levels are not satisfactorily decreased (< 25% removal). Flocculation-filtration removes metals (Pb, Cd, Cu, Ag, and Zn) from industrial wastewater, but Ag and Ni levels are not significantly decreased. Activated alumina can remove Se and As with maximum efficiency at pH 5.0-5.5. Activated carbon filters eliminate inorganic and organic Hg compounds. (Cassar-FRC)
W82-06608

MAKING CHLORINATION TRUSTWORTHY,
Fischer and Porter Co., Warminster, PA.
W. H. Nagel.
Water/Engineering and Management, Vol 129, No 7, p 38-39, June, 1982. 6 Fig.

Descriptors: *Monitoring, *Chlorination, *Control systems, *Water treatment, Electrical equipment, Disinfection.

Several methods are suggested to ensure that chlorine concentrations in the water treatment process remain within the desired range. Limit switches automatically signal by alarm light or horn that an abnormal condition is present. High and low vacuum switches indicate a variety of troubles in the system. The high vacuum switch detects deplated chlorine supplies, clogging, and blockages. It may be connected to a well pump to prevent pumping of unchlorinated water. The low vacuum switch indicates ejector failure and closing of valves in water or chlorine solution lines. A direct current signal monitors the chlorine gas flow and signals departures from the set limits. The above three systems provide instantaneous information to the operator. Trip switches may be attached to a chlorine residual recorder. This measures the most reliable parameter, chlorine residual, but there is a 4-8 min delay period, during which no chlorination may be taking place. Another approach involves supervision of incoming electrical signals from a mainline water flow transmitter and/or chlorine residual analyzer controller. The methods listed in this paper may be used in various combinations to increase the reliability of the monitoring system. (Cassar-FRC)
W82-06639

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,
Brown and Caldwell, Walnut Creek, CA.
D. T. Merrill, and D. S. Parker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256835, Price codes: A04 in paper copy, A01 in microfiche. OWRT Report, February, 1982, U.S. Department of the Interior, Washington, DC. 42 p, 9 fig, 15 Tab, 5 Ref, 3 Append. OWRT C-90070-R(No 9413)(1), 14-34-0001-9413.

Descriptors: *Industiral water, *Tertiary wastewater treatment, *Sealing, *Corrosion control, *Ozonation, *Cooling water, Cooling, Cooling towers, Air conditioning, Economic aspects, Municipal wastewater, Ozone, Corrosion, Fouling, Deterioration, Water treatment, Calcium compounds.

Study was undertaken to determine whether the beneficial performance of ozone (biofouling, corrosion, and chemical scaling control), when used as the sole source of cooling water treatment for air-conditioning systems, could be obtained at higher cooling water temperatures typical of industrial cooling with secondary municipal effluent (SME) used as the cooling medium. A pilot cooling system was constructed, and a 6-month experimental study initiated to determine process limits, mechanisms of scaling inhibition by ozone, and to evaluate factors influencing technical/economic feasibility. It was found that, while ozone used adequately controlled corrosion and biofouling, chemical scaling could not be prevented at conditions necessary for significant economic justification. Calculations indicate that the makeup waters (SME) used will become saturated with respect to calcium phosphate at less than 2 cycles of concentration; hence, a scaling potential exists at conditions less stringent than those used in the present study. It is recommended that ozone for scaling elimination in recirculating industrial cooling systems be dropped from further consideration where the makeup water is SME. (Zielinski-MAXIMA)
W82-06709

ULTRAVIOLET SYSTEMS IN WATER TREATMENT,
C. Jevons.
Effluent and Water Treatment Journal, Vol 22, No 4, p 161-162, April, 1982. 1 Tab.

Descriptors: *Disinfection, *Ultraviolet radiation, *Microorganisms, *Water treatment, Bacteria, Yeasts, Molds, Viruses, Protozoa, Algae, Parasites.

Guidelines are presented for selection and application of ultraviolet (UV) systems for disinfection in water treatment plants. Selection of an accurate sensor, which only responds to the germicidal wavelength, can prevent loss or reductions in intensity caused by lamp failure, malfunctions, or deterioration and poor water quality. It can be incorporated in an alarm system or automatic shut-off valve to prevent inadequately treated water from passing into the distribution system. Automatic switches are available to shut off lamps during no-flow periods. This prevents overheating of the equipment. A UV sterilizer unit must be selected so that it does not operate beyond its design capacity. A table is given describing the required energy for various microorganisms. These are (in microwatt sec per sq cm) 2,500-26,400 for bacteria, 6,600-17,600 for yeasts, 11,000-330,000 for mold spores, 6,600-440,000 for viruses, 22,000 for Chlorella, 200,000 for paramecium, and 9,200 for nematode eggs. The proper location of the UV unit should be as near as possible to the first take-off point in a straight line system for no storage or dead legs. A system with storage, ion exchange, filters, etc. offers many opportunities for bacterial growth. To prevent bacterial contamination in systems with raw water containing < 100 bacteria per ml, a UV unit should be installed prior to any other water treatment step. For less contaminated raw water, periodic sterilization is sufficient. Suggestions for location of the UV unit are given for systems with a treated water storage tank (on a continuous loop with 2 hours circulation time), large systems (point of use), and high purity systems (prior to the submicron filter). (Cassar-FRC)
W82-06726

GEOSMIN AND 2-METHYLISOBORNEOL FROM CYANOBACTERIA IN THREE WATER SUPPLY SYSTEMS,
Southern California Metropolitan Water District, La Verne.
G. Izaguirre, C. J. Hwang, S. W. Krasner, and M. J. McGuire.
Applied and Environmental Microbiology, Vol 43, No 3, p 708-714, March, 1982. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Water treatment, *Drinking water, *Organoleptic properties, *Water supply systems, Water quality, Taste, Odors, Odor-producing algae, Taste-producing algae, Algae, *California, Reservoirs, Pipelines, Lakes, Geosmin, 2-Methylisoborneol, Cyanobacteria, Bacteria.

In efforts to solve objectionable taste and odor problems in drinking water in California, four different filamentous cyanobacteria were isolated from three water supply systems. The first, Oscillatoria curviceps, was isolated from a widespread infestation in the littoral zone of Lake Mathews. The second, O. tenuis var. levis Gardner, was isolated from a sediment sample taken from Phoenix Lake. A third, O. simplicissima Gomont, was isolated from a raw water pipeline downstream from Lake Mathews, where it was growing among a tangled mass of dead Cladophora. The fourth, Anabaena scheremetievi Elenkin, was isolated from a mixed bloom in Tinemaha Reservoir. Each of the water supply systems served by these water bodies had experienced taste and odor problems. Unialgal cultures, free of actinomycetes, were purged using the Grob closed-loop stripping analysis method, and the resulting methylene chloride extracts were analyzed on a gas chromatograph/mass spectrometer. Geosmin was produced by O. simplicissima and A. scheremetievi, and 2-methylisoborneol was produced by O. curviceps and O. tenuis. These compounds are the two major causes of earthy-musty tastes and odors in water. In three instances, the major odorant found in culture was previously identified in the water or sediment sample from which the respective organism was isolated. O. curviceps was implicated in a taste and odor episode involving 2-methylisoborneol in a major reservoir. Geosmin and 2-methylisoborneol were easily detected with culture samples of only 4 to 25 ml. (Baker-FRC)
W82-06740

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W82-06768

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,
Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.
C. B. Fliermans, G. E. Bettinger, and A. W. Fynsk.
Water Research, Vol 16, No 6, p 903-909, June, 1982. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Cooling towers, *Bacteria, Public health, Water treatment, Chlorination, Human diseases, Legionella pneumophila , Industrial water, Water pollution sources.

Open recirculating cooling tower systems and evaporative cooling air conditioners were studied for levels of Legionella pneumophila. The cooling towers studied were mechanical updraft systems with circulation rates of 750-83,000 gal/minute. Sources of make-up water were varied but included well water and public and private potable water. In most cases the cooling towers were chlorinated intermittently, with the treatment dose adjusted to achieve a free residual chlorine level of 0.2 to 1.0 mg/liter for a given frequency. Regardless of the biocidal treatment, the source water or the frequency of biocidal addition, every tower tested contained L. pneumophila at detectable levels. The survey data from the South Carolina towers indicated that those supplied from underground wells had lower densities of L. pneumophila than towers receiving surface water. None of the systems showed an obvious seasonality trend for the bacteria densities. The data suggest that if continuous chlorination were stopped before L. pneumophila concentrations declined to levels comparable to densities in the source water, rapid infection of the tower would occur. Thus it was concluded that even in a well maintained cooling system, L. pneumophila does occur, and elevated numbers may be reduced through chorination. (Baker-FRC)
W82-06769

COMPLEX SEQUENCE TREATS FLUCTUATING FLOWS,
World Water, Vol 5, No 6, p 30-31, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Industrial water, *Ion exchange, *Water softening, *Water treatment, Martfui Vegetable Oil Works, Tisza River, *Hungary, Boiler water, Cooling water, Process water, Firefighting water, Suspended solids, Filtration.

An unusual, complicated water treatment system produces industrial water for four purposes at the Martfui Vegetable Oil Works in Hungary from Tisza River, a highly variable raw water source. The plant requires boiler feed water, cooling water, process water, and firefighting water. Suspended solids in the river water fluctuate from 10 to 3000 mg per liter; oxygen demand, from 3 to 20 mg per liter potassium permanganate; and total hardness, 5 to 16 degrees, (German Scale). The process water and firefighting water are produced by heating the raw water to 20 C with waste stream, passing it through lime-softening reactors, and pressure filtration. The process water is treated further by ion exchange desalination to make high quality boiler feed water and by chlorination and addition of algicides, bactericides, and sodium hexametaphosphate corrosion inhibitor to make cooling water. (Cassar-FRC)
W82-06814

A GUIDE TO TREATMENT FOR BACTERIAL PROBLEMS,
National Water Well Association, Worthington, OH.
S. Smith.
Water Well Journal, Vol 36, No 7, p 46-47, July, 1982.

Descriptors: *Bacteria, *Disinfection, Wells, *Chlorination, *Water treatment, *Well water.

Wells may be disinfected with two complementary techniques--shock treatment (single-dose cleaning and disinfection) and an in-well disinfection device (chlorination by chemical feed pumps or pellet dispensers). Activated charcoal filters are available to remove chlorine taste and organic compounds, if desired. Ceramic micropore filters can serve as a final quality control for bacteria-free water. For prevention and treatment of bacterial problems in wells, the following are recommended: chlorinate drilling water and disinfect downhole equipment and casing, chlorinate the new well with a 25 ppm Cl residual, wash gravel packing in chlorinated water, test water samples regularly for bacterial count, use shock chlorination at 1000 ppm for 24-48 hours if low concentrations of bacteria are found, and install permanent chlorination if iron or sulfur-oxidizing bacteria are a continuing problem. (Cassar-FRC)
W82-06847

5G. Water Quality Control

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
For primary bibliographic entry see Field 5D.
W82-05913

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. M. Wright, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243437, Price codes: A07 in paper copy, A01 in microfiche. Report, Janaay 1982. 128 p, 28 Fig, 17 Tab, 76 Ref, 7 Append. OWRT A-056-PA(1), 14-34-0001-1140

Descriptors: *Phosphorus removal, *Mathematical models, *Aquatic productivity, *Environmental effects, *Stream improvement, Phosphorus, Water quality standards, Respiration, biomass, Aquatic productivity, Nutrient requirements, Domestic wastes, Wastewater, Model testing, Aquatic plants, Aquatic populations, ecological effects, Rehabilitation, Regeneration.

Assessment was made of water quality and growth magnitude of rooted aquatic plants in a nutrient-enriched shallow stream system to provide a basis for evaluating the recovery of the ecosystem following implementation of a phosphorus (P) removal program. this program utilized spray irrigation of treated domestic waste water. Field studies were used to define temporal and spatial changes of aquatic plant biomass in selected study areas. A plant biomass model was evaluated, refined and calibrated to predict macrophyte biomass change as a function of varying environmental factors. The potential of this model as a management tool to assess the impact of nutrient reductions on stream oxygen budgets was studied. the model defined the biomass production rate as a function of specific photosynthetic and respiration rates, advective loss, and plant mortality. An empirical equation defining photosynthetic rates as a function of irradiance, nutrient availability, temperature, and plant maturity was formulated. From Michaelis-Menton kinetics, half-saturation constants of 313 kcal/sq m/day and 4.7 micrograms/liter P were estimated for light intensity and P functions, respectively. The empirically-derived value for the maximum specific photosynthetic rate for the study stream was 0.572/day. Monthly plant respiration rates were deducted from biomass simulations using literature-derived plant mortality rates. (Zielinski-MAXIMA)
W82-05919

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
For primary bibliographic entry see Field 6G.
W82-05923

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,
For primary bibliographic entry see Field 6E.
W82-05986

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,
Compagnie Generale des Eaux, Paris (France).
F. Damez, and M. Rapinat.
Aqua, No 2, p 397-406, 1982. 24 Fig, 28 Ref.

Descriptors: *Water quality control, *Water treatment, *Reservoir construction, *Design criteria, *Multipurpose reservoirs, Reservoirs, Storage reservoirs, Ammonia, Turbidity, Water quality management, Mixing, Injection, Water supply, Organic compounds, Equalizing basins.

The Mery-sur-Oise storage basin was designed to allow sheets of pollution from the Oise river to pass by while raw water supplies continue to feed in to the Oise water treatment plant. The basin was also intended to homogenize water quality by a process similar to that governing the biological purification taking place in waterways. Limnological studies were conducted to check whether the biological development of the reservoir, and of algae in particular, entails a deterioration of water quality. Results showed that the action of the injectors brought algae into constant contact with zooplankton which destroyed them. Pilot operations showed that storage allowed turbidity abatements of about 60%, a drop in the organic content of 30%, and an ammonia reduction of approximately 30%. The technical developments of the basin have successfully combined water quality objectives with water supply goals. (Geiger-FRC)
W82-06013

IMPACT OF THERMAL STANDARDS ON POWER PLANT WATER CONSUMPTION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta, and T. E. Croley,II.
Water Resources Bulletin, Vol 17, No 3, p 423-430, June, 1981. 5 Fig, 1 Tab, 10 Ref. A-061-IA. 14-34-0001-9017.

Descriptors: *Thermal discharges, *Standards, *Powerplants, Cooling water, Effluent standards, Thermal water, Water consumption, Missouri River, Mississippi River, Water loss, Evaporation, Rivers, Electric powerplants.

The EPA has mandated that powerplant thermal discharges into natural rivers will not be permitted after July 1, 1983. This paper shows the powerplant water consumption (evaporative water loss) for free discharge, no discharge, and several temperatures between these extremes for existing and proposed plants along the Missouri and Upper Mississippi Rivers in the Mid-Continent Area Power Pool. For the Upper Mississippi River, the difference in annual water consumption between free discharge (105.6 million cu meters, no cooling towers) and no discharge (148.1 million cu meters, enclosed cooling systems) is 42 million cu meters or 40%. For a temperature rise of 3 F above normal, water consumption would be 128.9 million cu meters, the same as the existing situation (37.3 million cu meters evaporation from the river surface and 91.5 million cu meters evaporation from cooling towers). Temperatures 1 or 2 F above normal produce almost the same evaporative loss, about 129 million cu meters. Figures for the Missouri River show a 6.5 million cu meter spread (10%) between free discharge (61.3 million cu meters) and no discharge (67.8 million cu meters). There is no significant increase in water consumption at 2 or 3 decrement from the allowable 5 F temperature rise. In areas where existing temperature standards overprotect the environment at the expense of increased water losses and energy usage, the standards should be adjusted to reflect a desirable balance between environmental protection and the costs of energy production cooling. (Cassar-FRC)
W82-06057

NEW DIRECTIONS IN WATER POLLUTION CONTROL,
Environmental Protection Agency, New York. Region II.
R. T. Dewling.
Clearwaters, Vol 12, No 1, p 7, March, 1982.

Descriptors: *Water pollution control, *Reviews, Legal aspects, Federal jurisdiction, Management, Planning, *Environmental Protection Agency.

Reform processes currently being undertaken in the water pollution control program as directed by the Environmental Protection Agency (EPA) are outlined briefly. The recent amendment of the municipal wastewater treatment construction grants program focuses efforts on achieving results through reduced federal involvement and increased state delegation. A problem of inefficiency of wastewater treatment plants in region II seems to result from a non-compliance factor. A diagnostic review of treatment plants in the region has been started, involving four phases: preliminary investigation, on-site inspection of every aspect of plant operations, identification of problems and drawing conclusions, and solution and implementation planning with both short and long term corrective actions. EPA has also begun a campaign of collecting overdue bills, which amount to millions of dollars nationally. Use of funds on actions which work directly toward improving water quality is stressed. Ocean dumping of sludge is being investigated. (Baker-FRC)
W82-06071

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 4A.
W82-06097

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12
Huff and Huff, Inc, Chicago, IL.
L. L. Huff, and J. E. Huff.
Illinois Department of Energy and Natural Resources, Chicago, Doc No 82/08, April, 1982. 78 p, 5 Fig, 21 Tab, 14 Ref, 1 Append.

Descriptors: *Combined sewer overflows, *Water quality standards, *Economic impact, *Primary wastewater treatment, *Secondary wastewater treatment, Wastewater, Effluents, Cost, Environmental effects, Heavy metals, Bacteria, Cost-benefit analysis, Biological oxygen demand.

East St. Louis discharges to the Mississippi River a primary effluent as well as combined sewer overflow (CSO); a regional plant is under construction to provide secondary effluent treatment. The city has petitioned the Pollution Control Board to exempt it from Rule 602. To comply with the rule would cost $20.9 million plus annual cost of $3.19 million. Treating first flush only would still require a $14.3 million investment. The city examined four control alternatives including combinations of first flush storage and treatment, treatment in the new plant, chlorination, and use of bar screens. The environmental effects of CSO discharges were categorized as to heavy metals, bacterial concerns, and deoxygenating waste characteristics. Iron and fluorides were potential problems, but if East St. Louis meets all water quality standards, the environmental effects would be nil. Bacterial levels can be controlled by regional disinfection. Deoxygenating wastes from CSO is the main factor in determining CSO control. Present CSO loading is about 0.81 million pounds of BOD5 per year. The treatment plant annually discharges about 6.1 million pounds; therfore, the city is one factor in maintaining overall water quality. With existing conditions, the maximum DO violation rate is about 1.1days/year; first flush treatment could lower the rate to 0.33 but the unit costs triple. Full compliance with Rule 602 would lower the violation rate to 0.26 days/year. The cost to East St. Louis of secondary treatment could boost sewerage expenses 3 to 4 1/2 times (total annual cost: $4.4 to $5.6 million), and such increased obligations would cause serious adverse effects on other municipal services. (Atkins-Omniplan)
W82-06099

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,
Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
D. S. Sawicki, L. B. Judd, G. Eggeleston, C. Bluemke, and D. Dupies.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243627, Price codes: A04 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS WRC 82-01, 1982. 59 p, 6 Tab, 11 Ref, 1 Append. OWRT A-089-WISC(1), 14-34-0001-1153.

Descriptors: *Water quality management, *Nonpoint pollution sources, *Institutional constraints, *Urban planning, Surveys, Water quality, Water quality control, Pollution load, Institutions, Water pollution prevention, Urban areas, Urban runoff, Water pollution control, Management planning, Water pollution sources, Urbanization.

Two approaches to address problems associated with nonpoint water pollution sources and institutions and processes charged with solving these problems are discussed. The first approach considered nonpoint source problems (especially for urbanizing areas) and available methods for their control. Problem solutions were classified, and used to further the understanding of institutional considerations for controlling nonpoint water pollution sources. The second approach undertook an examination of seven urbanizing communities in southeastern Wisconsin, assessing their abilities and willingness to deal with nonpoint water pollution sources, and considered the need for encouragement/reward by a higher unit of government. It was concluded that pollution reduction must be established as an objective for each of many administrative units with one unit as the prime motivator; the State has the administrative/technical/financial resources to measure problems, identify solutions, and delegate authority for effecting the solutions where appropriate. A third approach, considering an analysis of current nationwide efforts to implement nonpoint source controls for water pollution, is addressed in a separate report. (Zielinski-MAXIMA)
W82-06147

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06153

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5B.
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 5B.
W82-06159

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,
San Francisco Bay Inst., CA.
For primary bibliographic entry see Field 6E.
W82-06182

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,
Mathes (John) and Associates, Inc., Columbia, IL.
G. M. Mathes.
Civil Engineering (New York), Vol 52 No 6, p 58-59, June, 1982. 2 Fig.

Descriptors: *Aquifers, *Oil pollution, Groundwater pollution, Water quality, Wells, Monitoring, Pipelines, Water pollution prevention, Water pollution sources, Hartford, *Illinois, Oil refineries, Oil recovery.

Fires and odors kept reccurring in and around the Village of Hartford, Illinois, during the period from 1966 through 1978, with greater frequency of occurrence being noted in the spring of 1978. Study indicated that man-made and natural sources of combustible air-gas mixtures were present in and near Hartford. Some of the odors were coming from an underground accumulation of spilled petroleum products trapped on top of groundwater of the Mississippi aquifer which underlies a major part of the East St. Louis metropolitan area. Petroleum products in the spill were presumably lost from underground pipelines which traverse the Village between the refineries and shipping terminals on the Mississippi River. Early containment and recovery of any major quantities of the spilled petroleum products were of paramount concern. A comprehensive network of monitoring wells was installed throughout a significant portion of the Village. These wells permitted the preparation of contour maps and cross section drawings. Three main pools of the petroleum product were located. Two containment and recovery system designs were prepared. These allowed for recovery of spilled petroleum in virtually pure form and included consideration of the seasonal and historical fluctuations in the aquifer, the possible need for low volume pumping to create local increases in the gradient at a future date to expedite flow, and the possible need for high capacity wells to change flow gradients throughout the area should migration begin. Reports of odors have decreased. The performance and the economic efficiency of the recovery systems have minimized the cost of managing the spill. (Baker-FRC)
W82-06185

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,
Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
D. T. Lordi, C. Lue-Hing, S. Whitebloom, and R. Lanyon.
Industrial Wastes, p 16-18, 20, 25, March-April, 1981. 4 Tab.

Descriptors: Water quality control, *Industrial wastewater, *Water quality standards, *Mathematical studies, Water pollution prevention, Water pollution control, Water pollution, Industrial wastes, Heavy metals, Cadmium, Sludge.

The calculation of removal credits, the credit given by Publically Owned Treatment Works (POTW) to industries attempting to control their output of water pollutants, is described and some restrictions and conditions which must be met in order for a POTW to grant removal credits are discussed. The basic determination and calculation of removel credits are discussed. The basic determination and calculation of removal credits are presented, along with some restrictions on the calculation of consistent removal. For POTW that bypass untreated wastewater to receiving waters at least once annually, two alternatives exist for applying for removal credits. Under the first alternative, specific conditions must be met by the POTW and the industries involved, while under the second alternative, a calculation for removal credits is provided which lowers the amount of the credit by the fraction of time that bypassing occurs. No removal credit can be applied to pollutants such as Cd that accumulate in POTW sludges. In order to continue a removal credit program with EPA approval, the POTW must monitor and report, twice annually, the POTW removal capabilities, a requirement which will most likely lead to changing standards. (Geiger-FRC)
W82-06207

DETROIT-STYLE CSO STUDIES,
Black and Veatch, Kansas City, MO.
M. J. Graham.
Water/Engineering and Management, Vol 129, No 5, p 22-23, 25-26, May, 1982. 4 Fig.

Descriptors: *Combined sewer overflows, Planning, *Storm wastewater, *Storm-overflow sewers, *Overflow, *Detroit, Model studies, Municipal wastewater, Rouge River, Detroit River, Data collections, Michigan.

One of the most comprehensive combined sewer overflow (CSO) studies to date was completed by the Detroit Water and Sewerage Department in the fall of 1980. Data from the study are to be used to calibrate and verify a number of interacting computer models which assess the potential improvement in water quality in the Rouge and Detroit Rivers resulting from overflow control. Five separate models were developed to assess the most cost-effective CSO management alternative. These models were: System, a simplified skeletonized sewer system model with major sewers and interconnections, routed dry weather flow supplemented with storm flow to treatment, storage or overflow; Detroit Sewerage Treatment Plant Simulator, in which effluent quality discharged to the receiving stream was computed based on influent quality and quality from the system model; Rouge River, in which water quality of the Rouge River in various reaches was computed based on fractors of CSO quantity and quality and on background river quality; Detroit River, in which river quality was given based on upstream background, CSOs, Rouge River quantity and quality, and DWWTP effluent; and Detroit River Plumes, which modeled quantity and quality of CSOs from the system to give near-shore quality. The sampling process employed to secure enough data for study was massive. Almost 25,000 individual analyses were entered into the data bank for the system model alone, and an additional 10,000 analyses, including instantaneous flow measurements, were collected for the river models. About 5,000 additional pieces of information on flow and quality were entered for calibration of the treatment plant model. This was probably one of the most comprehensive data collection programs performed for facilities planning purposes. (Baker-FRC)
W82-06247

THE USE OF WATER QUALITY OBJECTIVES IN SEINE-NORMANDIE,
Agence Financiere de Bassin Seine-Normandie (France).
A. Lesouef.
Water Pollution Control, Vol 81, No 2, p 255-265, 1982. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Water quality, *Regulations, *France, Seine-Normandie Basin, Basins, Industrial wastes, Public policy, Public participation, Public opinion.

The Seine-Normandie Basin covers an area of about 96,000 square kilometers and a population of more than 15 million. Industry is important in the basin, with the result that river water quality is affected by both the main cities and industrial activities. With the exception of the sewage treatment plant of Acheres, little was achieved in the way of water quality control until the 1960s. The basin was divided into convenient sub-basins for each of which the following steps were carried out: identification of water use, water quality control, and current water quality assessment. Uses identified included drinking, fishing, swimming and recreation, and industrial usage. Due to its possible consequences on the socioeconomic activities of a particular region, a water quality objective approach should rely on a fair degree of commitment from the public who will have to support its consraints and also benefit from it. Negotiations to establish such a program are long. The different steps of this long process include the preparation of technical files and recommendations, the presentation of the material to administrative services, the presentation of the agreement to a delegated basin commission, presentation of the agreement to a delegated basin commission, presentation to the sub-basin committee, presentation to regional chambers of commerce and industry as well as regional chambers of ariculture, public hearings, summaries of public meetings, proposals to all groups, implementation, and follow-up. Despite the high amount of time and effort needed to follow this long path, it is considered that this approach is worthwhile in France. (Baker-FRC)
W82-06254

LABORATORY SERVICES IN REGIONAL WATER AUTHORITIES,
Anglian Water Authority (England). Scientific Services.
A. W. Davies.
Water Pollution Control, Vol 81, No 2, p 177-184, 1982. 3 Fig, 1 Tab, 1 Ref.

Descriptors: *Water analysis, *Scientific personnel, Personnel, *Laboratories, Research facilities, Water supply development, Water resources development, Chemical analysis, England, Anglian Water Authority.

The importance of laboratories and scientific staff in fulfilling the commitment to provide a wholesome supply of water to the public is considered. There are three basic types of water laboratories: quality control laboratories associated with sewage and water treatment plant operations; laboratories concerned with the mesurement of pollutants in rivers, distribution systems, reservoirs, industrial effluents and dewage, and industrial waste discharges; and central or regional laboratories, whose tasks include inter- and intra-laboratory calibration of methods of quality measurement against standards, the development of new scientific methods to accommodate changing requirements, and the coordination of scientific applications in operational laboratories. The laboratories in the Anglian region during the year 1980 produced about 2.6 million items of information, for which the most important uses include: compliance data representing the analytical results of samples taken of industrial and agricultural consent and unconsented discharges to surface and other waters; operational data to manage a sewage treatment or water supply works efficiently; investigative data required for many different purposes; and administrative data to satisfy national commitments, to answer specific questions, to satisfy water quality directives, and to identify quality trends. Specific responsibilities of the water scientist are listed. Several generalizations are listed which are intended to increase appreciation for the science of water quality. (Baker-FRC)
W82-06256

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
P. Harremoes.
Water Research, Vol 16, No 7, p 1093-1098, July, 1982. 6 Fig, 4 Ref.

Descriptors: *Rivers, *Oxygen depletion, Depletion, Oxygen, Organic matter, Decomposing organic matter, Organic carbon, Sedimentation, Kinetics, Chemical reactions, Fate of pollutants.

A theoretical analysis has shown that removal of organic matter from rivers can adequately be simulated with a first order removal by both extraction and sedimentation, which will fix the organic matter at the bottom. The condition is that the river can be considered vertically well mixed as compared to the rate of removal. It is argued that the removal gives rise to an immediate and a delayed oxygen demand on the river water in

accordance with the original suggestions made by Velz and Gannon. These phenomena are important for the oxygen depletion experienced in rivers, especially in case of abrupt discharges. Investigation of oxygen depletion generated by a steady-state discharge of partly treated sewage showed a significantly faster removal than can be explained by degradation in the water phase and a significant accumulation of organic matter at the bottom. A simplified theoretical analysis of an abrupt discharge showed that both the immediate and the delayed oxygen consumption can adequately be handled by modifications to the traditional oxygen sag analysis. This analysis shows the extreme importance of making a distinction between the biochemical oxygen demand that will be removed with an immediate oxygen consumption and the fraction that will be removed with a delayed consumption. The final conclusion is that additional study is needed to reveal the importance of this distinction. (Baker-FRC)
W82-06269

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,
For primary bibliographic entry see Field 6E.
W82-06295

GROUND WATER LAW IN PUERTO RICO.
For primary bibliographic entry see Field 6E.
W82-06296

GROUND WATER AND THE STATES,
For primary bibliographic entry see Field 6E.
W82-06297

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,
Verlag Chemie, Weinheim (Germany, F. R.).
For primary bibliographic entry see Field 5C.
W82-06299

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,
Metropolitan Washington Council of Government, DC.
For primary bibliographic entry see Field 6B.
W82-06361

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,
Vermont Water Resources Research Center, Burlington.
E. A. Cassell, D. W. Meals, Jr., and P. Daukas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256652, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 53 p, 25 Tab, 1 Ref, 2 Append. OWRT A-036-VT(2).

Descriptors: *Nonpoint pollution sources, *Public opinion, *Public participation, *Water pollution control, *Surveys, Priorities, Planning, Pollution load, Water pollution sources, Attitudes, Vermont, Public policy, Environmental protection, Resources management, Water management, Management planning, Water conservation, Water quality, Water quality control.

Opinion surveys were conducted in 1978 which were designed to ascertain public perceptions concerning nonpoint source (NPS) pollution, its causes, and its control. The survey results were assessed under two basic public categories: resource operators (farmers, loggers, and buildings contractors) and resource managers (scientists, planners, and resource managers in Vermont local, State, and Federal agencies). The results of the resource operators survey indicated a good general understanding of the NPS pollution problem, and a belief that NPS pollution could be avoided using proper practices. Also expressed was a willingness to help solve NPS pollution, but the lack of technical advice, guidelines, and finances were considered principal deterrents to participation. Results of the resource managers survey identified NPS pollution as an important Vermont issue over the next decade, with major priorities for NPS pollution control being careful problem assessment, basic data collection, public education, and development/implementation of useful conservation practices. Based on the results of these two public surveys, recommendations for enhancing Vermont NPS pollution control are advanced. Individual survey questionnaires used for farmers, contractors, loggers, and managers are included, and the definitive results of the surveys are tabulated. (Zielinski-MAXIMA)
W82-06372

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,
Australian Water Resources Council, Canberra.
Proceedings, Joint United States/Australia Seminar and Workshop, February 19-24, 1979, Melbourne. Australian Government Publishing Service, Canberra 1981. 915 p. Burns, F. L., and Powwling, I. J. (Eds.).

Descriptors: *Destratificatiion, *Thermal stratification, *Water quality, *Lakes, *Reservoirs, *Mixing, Water quality control, International commissions, Lake restoration, Stratification, Turnover time, Density stratification, Lake morphology, Water currents, Environmental quality, Environmental engineering, Environmental effects, Environmental control, Aquatic environment, Hydraulic engineering.

A workshop was convened to discuss destratification and its use to improve water quality in reservoirs and lakes. The proceedings incorporates the 40 papers presented, together with the ensuing discussing and descriptions of field presentations, covering engineering and science efforts in this field in the United States and Australia. The theme is progressively developed from the consideration of the stratified reservoir, through the techiques of destratification, to the consideration of the effects of such action. This is then followed by case studies from the two countries, and culminates in a general discussion bringing together those topics needing further elaboration. The various lake/reservoir mixing projects are also enumerated, with details provided on the methods and equipment used and the results obtained, covering 37 projects. The workshop was undertaken since the two countries cover roughly complementary latitudes north and south of the equator, and since it was felt that the solutions being tried in destratifying thermally-stratified waters would be similar and hence provide a mutual international benefit to advancing the understanding of lake/reservoir destratification approaches. (Zielinski-MAXIMA)
W82-06385

PHYSICAL-CHEMICAL TREATMENT AND DISINFECTION OF STORMWATER,
Ontario Ministry of the Environment, Toronto.
H. Kronis.
Research Report No 88, March, 1982. 112 p, 31 Fig, 30 Tab, 17 Ref, 2 Append.

Descriptors: *Water treatment, *Storm water, *Physiochemical treatment, *Sedimentation, *Disinfection, *Urban runoff, Water quality, Water quality control, Flocculation, Settling basins, Rainfall intensity, Runoff coefficient, Storm runoff, Suspended solids, Water pollution control, Pollutants, Iron, Chemical oxygen demand, Biological oxygen demand, Water analysis, Pollution load.

Urban runoff from a 22.7 hectare (essentially residential) metropolitan Toronto watershed was studied May-October, 1977, and April-July, 1978. Hydrologic events and stormwater quality were characterized, and simple treatment methos (coagulation/sedimentation and disinfection at the bench/pilot-scale level) were applied. Hydrologic parameters (rainfall intensity, runoff, storm sewer flowrates, total runoff volumes/event, antecedent dry periods, runoff coefficients) varied widely. Stormwater pollutant concentrations also varied widely, especially for suspended solids and chemical oxygen demand (COD). Typical average percentage pollutant removals by natural (NS) or chemically-assisted (CA) settling, respectively, for thirteen 1977 storm events were: 88 and 95% (suspended solids); 36 and 68% (BOD-5); 57 and 62% (COD); and 47 and 79% (total phosphorus). For CA settling, alum was the preferred flocculant (30mg/liter, foolowed by at least two hours of quiescent settling); about 10 hours of quiescent settling was estimated to be needed for NS. Indicator bacterial densities in raw stormwater did not vary significantly between events. Disinfection with NaOCl reduced bacterial densities to well below pollution objectives. Of eight trace elements analyzed, only iron levels violated the model industrial waste bylaw. Total phosphorus and nitrogen runoff levels were consistently low and varied little. (Zielinski-MAXIMA)
W82-06389

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237199, Price codes: A02 in paper copy, A01 in microfiche. Report REC-ERC-81-16, November 1981. 19 p, 2 Fig, 7 Tab, 10 Ref, 1 Append.

Descriptors: *Desalination, *Saline water, *Springs, *Water reuse, *Water tretment, *Impaired water quality, Laverkin Springs, Colorado River, Water quality, Water use, Cooling water, Coal slurry pipelines, Deep well injection, Wastewater disposal, Pretreatment of water, Radioactivity, Demineralization, *Utah.

LaVerkin Springs (LVS) are highly saline springs which discharge into the Virgin River (a tributary of the Colorado River) in Washington County, Utah. The high salt content and moderate flow rates significantly contribute to the salinity of the Colorado River. Methods were evaluated for preventing high salinity LVS water from entering the Virgin River and for utilizing the process water in energy development. Analytical water data obtained from a 9-month test program at LVS test site were evaluated. The raw water typically contains 750 mg/l of dissolved carbon dioxide and has a pH near 6.0. It contains the following concentrations in mg/l: 820 of calcium, 150 of magnesium, 1266 of bicarbonate, 1860 of sulfate, 2220 of sodium, and 3345 of chloride. The raw water contains significant amounts of silica, boron, strontium, and sulfide, and a measurable amount of radioactivity. The relative merits of different methods of treatment, disposal, and reuse of LVS water were studied. The disposal of water by deep well injection, use as a secondary coolant in a binary cooling tower, use in solar salt-gradient ponds, and use as a transport media for coal slurry pipelines was found to be technically feasible. Use of LVS water to transport coal to a consuming powerplant and subsequent reuse in a binary cooling tower or solar salt-gradient ponds would achieve both objectives of salt reduction and energy conservation. (Moore-SRC)
W82-06400

HAZARDOUS MATERIAL SPILLS--ARE YOU READY,
East Bay Municipal Utility District, Oakland, CA. Water Quality Div.
K. E. Carns, and K. B. Stinson.
Journal of the American Water Works Association, Vol 74, No 5, p 224-228, May, 1982. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Chemical wastes, *Contamination, *Water supply, *Water pollution sources, Water pollution prevention, Water treatment facilities, Disasters, Water distribution, Waste disposal, Reservoirs, Highways, Oil spills, Protection, Spills.

Water utilities can reduce the disastrous consequences of hazardous material spills on highways and in or near public water supplies by preparing a written response plan and training personnel in emergency procedures. The East Bay Municipal Utility District serving 30 communities east of San Francisco Bay has developed such a plan, which is

composed of five chronological phases: (1) discovery and notification, (2) evaluation and initiation of action (includes notification of public agencies and key utility management personnel), (3) containment and countermeasures (directed by the spill coordinator with help available from CHEMTREC communicator, public notified if necessary), (4) cleanup, mitigation, and disposal (spill is cleaned up promptly, preferably by the spiller), and (5) documentation and cost recovery (written report of the event and assignment of costs). The response procedures are given in outline form, in flow diagram form, and in detailed form. The response plan was tested in two drills of hypothetical events (a tank truck of poisonous chemical sunk in a raw water supply reservoir and pesticide injected into the distribution system). Two actual emergencies in which no water contamination resulted illustrated the value of the plan. These were a spill of transformer oil into a stream and the discovery of several drums of illegally dumped hazardous waste near the district's largest reservoir. (Cassar-FRC)
W82-06417

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 5D.
W82-06455

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,
Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
For primary bibliographic entry see Field 2H.
W82-06473

RUTLAND WATER RAW WATER QUALITY - PROBLEMS AND MANAGEMENT,
Anglian Water Authority, Peterborough (England).
N. F. Low.
Hydrobiologia, Vol 88, No 1-2, p 93-101, March, 1982. 8 Fig, 10 Ref.

Descriptors: *Reservoirs, *Raw water, *Water treatment, Water supply, *Water quality management, Water quality, Land treatment, Sewage effluent, Drought, Reclaimed water, River basin development, Pumping, Pumps, Water quality control, Rutland Water, England.

The options available to control the expected water quality problems in Rutland Water are identified and their use is discussed. Water quality problems result from the eutrophic character of the input waters and from the excessive depth of the reservoir. Two groups of options are available: those which operate on input waters, and those which operate on the stored water. Both types of options will be used, since increased demand for water will result in the reduction of the retention time of the stored water and an increase in nutrient loading. (Titus-FRC)
W82-06475

MODELS OF ANNUAL CYCLES IN LENTIC WATER BODIES,
Salford Univ. (England), Dept. of Civil Engineering.
B. Henderson-Sellers, and P. B. R. Archer.
Hydrobiologia, Vol 88, No 1-2, p 89-91, March, 1982. 4 Tab, 2 Fig, 5 Ref.

Descriptors: *Mathematical models, *Computer models, *Water quality, *Lentic environment, *Stochastic models, *Deterministic models, Calibration, Ecological models, Standing water, Parametric hydrology.

Reasons for modeling water quality are discussed, and a summary of the relevant parameters is presented. The two major types of models, stochastic and deterministic, are described. Stochastic models are those in which elements of the model vary in a random fashion. Inaccuracies are decreased because the input data are not condensed in any way. Results may be more realistic, since they are associated with some degree of uncertainty; however, these models are time-consuming and costly. Deterministic models always produce the same result for a given set of data; they are functional representations of a system. Such models are more economical because they are easier to implement. With any model, a full validation is necessary before any confidence can be placed in the results it produces. Validation involves comparing the computed results with data from previous time periods. (Titus-FRC)
W82-06483

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,
Youngstown State Univ., OH Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 18, No 1 p 81-87, February, 1982. 3 Fig, 28 Ref.

Descriptors: *Mathematical models, *Irrigation, *Management planning, Irrigation design, Irrigation efficiency, Water management, Agriculture, *Salinity, Simulation analysis, Optimization.

Problems which may result from irrigated agriculture in arid and semiarid regions include accumulation of salts, destruction of soil texture, waterlogging, decline in fertility and yield, and eventual abandoning of the land. Many of these problems result from the failure of managers to understand that irrigated land is a system consisting of several interdependent components and that the health of each of these components individually is important to the overall health of the system. The important components of an irrigated system include the quantity and quality of the irrigation water, the quantity and quality of the irrigation return flows, the unsaturated zone, the saturated zone, the water balance of the irrigated system, the salt balance of the irrigated system, and the crop yield. A management model is described which considers each of these nine components in an effort to devise management strategies to halt or at least retard the salinization and waterlogging processes in irrigated agriculture. An optimization model is used to maximize net farm income, encourage conjunctive use of surface and ground water, devise water pumping and application strategies designed to maintain continuous movement of salts out of the system, maintain proper hydrologic balance within the irrigated system, and meet the concentration requirements of the drainage water needed to optimize the yield of individual crops. Simulation models are used to assess the impact of agricultural activities on the unsaturatdd zone and the saturated zone. (Carroll-FRC)
W82-06584

DISPOSAL OF SLUDGE TO SEA,
Oslo Commission (Norway).
For primary bibliographic entry see Field 5E.
W82-06595

NEW PROBLEMS WITH UPLAND WATERS,
Saint David's Univ. Coll., Lampeter (Wales).
D. Kay, and A. McDonald.
Water Services, Vol 86, No 1031, p 29, 31, January, 1982. 27 Ref.

Descriptors: *Landuse, *Catchment areas, Agriculture, *Great Britain, *Research priorities, *Water quality, *Forestry, Elevation, Terrain analysis, Nutrients, Bacteria, Escherichia coli, Enteric bacteria, Watersheds.

In a paper by Youngman and Lack, published in Water Services, 85, (1019), 13-14, 1981, it was suggested that the increased use of upland areas for either lamb production of afforestation will cause problems of nutrient enrichment in catchment streams and impoundments. The direction of research effort suggested by these authors to control the water quality of catchment areas is questioned. Instead of concentrating on upland area nutrient transport, an examination of the microbiological factors involved in water quality is recommended. The investigation of water quality in a multiple-use catchment area in a similar location to areas of pristine moorland is advocated to predict microbiological water quality deteriorations. Monitoring of E. soli levels in Yorkshire catchments has revealed that afforested areas produce lower enteric bacterial concentrations than sheep farming areas. An integrated management approach is advocated which would focus on water quantity and quality, nutrient transport, microbiological deterioration and recreational and agricultural activities. (Geiger-FRC)
W82-06602

A MODEL FOR THE DESIGN OF HYPOLIMNETIC AERATORS,
York Univ., Toronto (Ontario). Dept. of Biology.
C. T. Taggart, and D. J. McQueen.
Water Research, Vol 16, No 6, p 949-956, June, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Design criteria, *Aerators, Hydolimnio, *Aeration, *Wastewater treatment, Oxidation, Model studies, Performance evaluation.

An empirically derived model is presented for use in designing hypolimnetic aerators, which ensures maximum flow efficiency but may not maximize oxygen transfer efficiency. Diffusor depth, air flow rates, rise velocity and cross-sectional area of the riser tube are the major variables considered. Water flow values predicted by the model were correlated with those observed in twenty published field experiments. The model determined that some aerators are inefficient and their design could be improved. A discussion is presented of the required oxygen input during aeration in which the problems of hypolimnetic oxygen depletion rates and oxygen transfer efficiencies are considered. (Baker-FRC)
W82-06610

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,
Texas Univ. at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,
Geological Survey, Denver, CO.
J. T. Turk.
Water Resources Bulletin, Vol 18, No 1, p 75-80, February, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Water quality control, *Thermodynamics, *Mine drainage, Coal mines, Groundwater pollution, Dissolved solids, Chemical precipitation, Geochemistry, *Colorado.

Coal production in Colorado has increased significantly in the period since 1965, raising questions concerning the effects of mine drainage on water quality. Major dissolved ions that contribute to the overall salinity of the water, restricting its suitability for various uses, are frequently found in water from underground coal mines. Thermodynamics provides an effective tool for the assessment of the origin of seepage from underground coal mines and for prediction of compliance with water quality criteria of seepage from other mines within the same geologic formations. Analysis of samples from 13 of the 14 mines studied indicated that calite saturated water had probably reacted with sodium rich marine shales to produce the seepage, which was saturated or supersaturated with respect to calcite. Samples showing evidence of being most completely reacted were composed almost entirely of sodium and bicarbonate ions and had a calcium to sodium activity ratio similar to that of seawater. The one sample not saturated with calcite was saturated with respect to gypsum, probably as a result of simple dissolution of gypsum from the strata through which the groundwater percolated. The primary problems which might result from reuse of the mine drainage would be damage or destruction of crops if the drainage water were used for irrigation. Also, the

chloride and sulfate concentrations in some samples were in excess of recommended standards for public water supplies. (Carroll-FRC)
W82-06624

THE MATHEMATICAL MODELLING OF WATER QUALITY WITH PARTICULAR REFERENCE TO THE INDUSTRIAL RIVERS OF YORKSHIRE,
Yorkshire Water Authority (England). Directorate of Resource Planning.
P. R. Holmes.
Water Pollution Control, Vol 81, No 1, p 45-58, 1982. 4 Fig, 9 Ref.

Descriptors: *Mathematical models, *Water quality, *Industrial wastewater, Rivers, River flow, River forecasting, Management planning, Water management, Decision making, Water quality management, *United Kingdom.

There has been considerable reluctance in the United Kingdom to use models for river quality management. River modelling studies may be designed to aid river surveillance by interpolating flow and water quality between sampling points to draw attention to inconsistencies in routine data, or to predict future flow and water quality conditions, assuming that present inputs and outputs will remain unchanged except for discrete changes which are to be tested. The main categories of mathematical models are described and compared. The application of mathematical models to practical planning problems in the industrialized river catchments of Yorkshire is examined. This modeling concentrated on steady state mass balance modeling of flow and biochemical oxygen demand, supported by suspended solids and ammonium nitrogen, and using chloride to assist in the balancing due to its conservative nature. The resulting model is basically simple in structure and extensive rather than intensive in its representation of the real river and in its requirements for data. The steady state requirement limits the model to fairly low river flow conditions if catchment-wide modeling is to be conducted. Application of this model to the River Aire catchment is discussed. Data collection and analysis, model calibration, and use of the modeling results in management planning are described. Major deficiencies of the model are examined. It is concluded that this approach to river modeling has provided a simple, economic planning tool for river management. (Carroll-FRC)
W82-06644

A REVIEW OF INDUSTRIAL EFFLUENT CONTROL EXPERIENCE,
Thames Water Authority (England).
P. Brindley, D. C. Carter, and M. J. Linsmith.
Water Pollution Control, Vol 81, No 1, p 59-79, 1982. 20 Fig, 13 Tab, 16 Ref.

Descriptors: *Industrial wastewater, *Water pollution control, Wastewater treatment, Regulations, Water pollution sources, Water quality standards, Effluent limitations, Effluent charges, *Reviews, *Waste assimilative capacity.

Pollution control measures are used to regulate the demands on the assimilative capacity of the environment to be compatible with use requirements. The formation of water authorities in the United Kingdom in 1974 led to considerable standardization of the diverse control and charging systems previously used to regulate industrial effluents. The general procedures used in the Chiltern Division of the Thames Water Authority in developing consent agreements with respect to effluent discharges with individual companies are described. The steps taken in the establishment of an industrial waste treatment plant, and the limitations placed on that plant, are outlined. These limitations included limitations on wastes to be treated, effluents, and plant operations. The Thames Water Authority has also established a catchment quality control function to assess and, where possible, control the extent and nature of continuous contamination of lowland water resources with persistent chemicals. The methods used to achieve these goals are described. The factors which determine the industrial effluent limits are directly associated with the quality objectives of the products of sewage treatment. Metal standards relating to sludge applied to land and to river water quality have become more precisely defined since 1970. Since all treated sludges in the Chiltern Division are distributed to land for agricultural purposes, standards for industrial effluents contributing to these sludges have also become more strict. Industrial effluent testing procedures are discussed briefly. (Carroll-FRC)
W82-06648

THE CONTROL OF EFFLUENT AND WATER QUALITY IN AN IMPORTANT WATER SUPPLY CATCHMENT,
Severn-Trent Water Authority (England). Derwent Div.
K. Selby, and T. D. A. Tricker.
Water Pollution Control, Vol 81, No 1, p 97-111, 1982. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Water quality control, *Water quality management, *Catchment areas, River catchments, Water supply, Industrial wastewater, Water pollution control, Effluent limitations, Wastewater treatment, *United Kingdom, River Derwent.

The River Derwent in Derbyshire is one of the most highly utilized water-supply rivers in the United Kingdom and has a finer resource/demand balance than most rivers. The Severn-Trent Water Authority has had responsibility for the control of effluents and for water quality in this catchment since 1974. The River supplied significant quantities of water to textile and other industries in the district and is used extensively for recreational pursuits. A high proportion of the river flow is used water, much of which is derived from industry. The Authority's Directorate of Scientific Services is responsible for water quality control functions, which include the control of effluents from sewage treatment works and industries discharging directly to a watercourse, the protection of underground water resources, and the monitoring of the quality of water supplies. The issue and enforcement of consents to discharge are the major means used to protect the quality of surface and ground water resources. River water quality objectives for the catchment are presented, and efforts being made to achieve these objectives are discussed. The industrial discharges, and private septic tank systems on water quality and efforts being made to minimize their impacts are described. Water quality problems particular to the River Derwent include pollution emergencies, high dissolved oxygen concentrations, damage to sewage treatment processes due to the high proportion of industrial effluents in the sewage, problems with color due to the large number of textile effluents, problems with organic micro-pollutants related to industrial wastewaters, and organoleptic problems in water supplies. Sources of these problems and methods being used to ameliorate them are discussed, (Carroll-FRC)
W82-06652

A WATER QUALITY INDEX FOR LAKE BEACHES,
Eco-Recherche Ltd., Pointe-Claire (Quebec).
N. St. Louis, and P. Legendre.
Water Research, Vol 16, No 6, p 945-948, June, 1982. 2 Fig, 2 Tab, 10 Ref.

Descriptors: Water quality, Recreational facilities, Bacteria, *Coliforms, *Streptococci, Beaches, Lakes, Lake beaches, *Bacterial analysis, *Pollutant identification.

A water quality index was developed, based on total and fecal coliforms and streptococci concentrations. A linear combination of these three bacterial variations was sought, thus making it possible to weight them differentially. The index described results from the comparison of a group of beaches, all in the same area and subjected to similar uses. A total of 5651 samples were obtained from 42 sampling stations on 7 beaches and analyzed for bacterial concentrations. The study period was 10 years. Discriminant analysis of the data led to a cononical vector accounting for most of the variability of the three microbial count variables recorded. This discriminant axis ordered the beaches along a cline of increasing pollution. It is then transformed into a microbial water quality index calibrated for the given set of beaches, which is in turn used to study the medium-term variability and the long-term evolution of water quality of the beaches. (Baker-FRC)
W82-06660

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W82-06663

STATUS OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 8G.
W82-06665

EVALUATION OF EFFECTS OF STORMWATER DETENTION IN URBAN AREAS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256736, Price codes: A07 in paper copy, A01 in microfiche. Report, May 1982. 139 p, 24 fig, 7 Tab, 48 Ref. OWRT B-244-TEX-(1), 14-34-0001-1267.

Descriptors: *Storm water, *Urban areas, *Computer models, *Watersheds, *Detention reservoirs, Mathematical models, Mathematical studies, Model studies, Land use, Ponds, Storm runoff, Storm surges, Urban runoff, Catchment areas, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, Flood peak, Storage reservoirs, Suspended solids.

Research was carried out to assess stormwater detention effects on water quality and flood control in urban ares using computer models and measurement data. The technical efficiency of pollutant removal and flood control were measured and modeled for several existing pond systems. Further, stormwater management alternatives were defined at the watershed level, based upon detention storage analysis and watershed modeling. A developed optimum scheme is described for locating detention ponds within urban areas. In addition to the development of management alternatives, economic feasibility and implementation needs were examined at the subdivision and watershed level. It was concluded that maximum hydrologic input due to full urban development of a 1 sq mile catchment occurs between a 50-75% development phase, accounting for about 40% of the flow increase for peak flows. Detention storatge land requirements at the catchment level for reducing peak flows to undeveloped levels range from 6% of the load area (for a 10-ft outfall depth) to 16% (4-ft outfall). Model results for locating detention storage throughout a 10-mile watershed indicate no need for any storage at the most down stream pond system was found efficient for suspended solids removal (1200 mg/liter inflows reduced to 100 mg/l at outflows) over a range of storm flows and durations. (Zielinski-MAXIMA)
W82-06698

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),
Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
For primary bibliographic entry see Field 6F.
W82-06714

50 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (50 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER

WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
P. Koppe, K. H. Kornatzki, E. A. Nusch, F. Dietz, and G. Reinnarth.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 17-29, January, 1982. 9 Fig, 13 Tab, 26 Ref. English summary.

Descriptors: *Lakes, *Lake sediments, *Ecosystems, *Nitrification, Ecology, Hydrology, Denitrification, *West Germany, Lake Baldeney, Nitrogen fixing bacteria, Mineralization, Sediments, Lake morphology, Limnology, Artificial lakes, Ruhr River, Water resources development, Aeration, Dredging, Heavy metals, Pollutants, Water quality.

Lake Baldeney, an impoundment of the Ruhr river in West Germany, is a hydrological hybrid which can be described in a simplified form as a double-channel two-layer model. The layers comprise a shallow lentic area with a low speed of flow and thick sediment layer and a deeper lotic area in which flow speed is significantly higher and almost no sediment is deposited in some spots. The mineralization of sediment from the lentic zone and the reduction in organic material in solution show that the lake is highly capable of water purification. Heavy metals are also deposited in the lake, whence they can be removed by dredging. Denitrification processes and the release of ammonia (mostly from sediment) also influence water quality. When a sudden high pollution load occurs (e.g. through a heavy rainstorm) the lake acts as a buffer. The nitrification rate is significantly higher at the inflow to the lake than at the outflow; this is attributable to a reduction in the number of nitrifying bacteria, probably because they adhere to suspended solids which are deposited in lake sediment. Gas exchange (nitrogen, carbon dioxide, oxygen) with the atmosphere cannot be measured accurateley, as the sediment acts as a store for organic and inorganic material as well as producing its own organic material. Research should therefore be performed on the interaction between sediment, suspended solids and water as well as on ecological interactions within the biological community. Lake Baldeney should be monitored constantly and aeration should be performed when oxygen metabolism so demands. Dredging will eventually be necessary due to continuing sedimentation. (Gish-FRC)
W82-06716

CALCULATING CONSENT CONDITIONS TO ACHIEVE RIVER QUALITY OBJECTIVES,
Anglian Water Authority (England). Dept. of Operational Planning.
A. E. Warn.
Effluent and Water Treatment Journal, Vol 22, No 4, p 152-153, 155, April, 1982. 12 Ref.

Descriptors: *Water quality standards, *Effluent standards, *River regulations, Water quality control, Standards, Regulations, Flow regulation, *Monte Carlo method, Sampling, Errors.

River Quality Objectives (RQO) are defined as the river quality needed to protect the intended uses of rivers. Their purpose is to ensure a proper allocation of resources to problems of river quality. Methods for calculating consent conditions to use in RQO are discussed. The Combining Distributions Methods (CD) are analytical solutions. They are simple to use and can be done on a programmable calculator. The Monte Carlo Method or Simulation Method requires more computer resources, but can be applied to a wider range of problems. The disadvantages of the simple mass balance equations are shown, for example, the adoption of unachievable RQO and underestimation of the self-purification capability. Use of the CD or Monte Carlo methods shows that river flow regulation is a senseless way of achieving river quality objectives. (Cassar-FRC)
W82-06725

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
For primary bibliographic entry see Field 5C.
W82-06733

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,
Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5F.
W82-06769

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
R. Field.
Water Research, Vol 16, No 6, p 859-870, June, 1982. 19 Fig, 2 Tab, 33 Ref.

Descriptors: *Combined sewers, *Reviews, *Storm-overflow sewers, Sewers, Storm water, Storm runoff, Retention basins, Catchbasins, Flushing, Design criteria, Polymers, Infiltration, Storage.

A state-of-the-art assessment is made of the activities of the Environmental Protection Agency's Storm and Combined Sewer Program over the past 15 years. The topics relate to collection systems and in particular to the management of collection systems for the dual purposes of drainage and pollution control, along with maintenance of such systems. Specific topics touched upon include catchbasins, new sewer design, sewer flushing, polymer injection, infiltration/inflow controls (Insituform, impregnated concrete pipe, and trenchless sewer), upstream storage/attenuation, flow routing and in-pipe storage, new types of flow regulators (swirl and helical bend regulator/concentrators, fluidic regulator, and hydrobrake), and new tide gates. In many cases where revision is necessary, the emphasis is placed upon optimal utilization of the existing facilities. (Baker-FRC)
W82-06775

LAKE RESTORATION BY SEDIMENT REMOVAL,
Corvallis Environmental Research Lab., OR.
S. A. Peterson.
Water Resources Bulletin, Vol 18, No 3, p 423-435, June, 1982. 5 Fig, 88 Ref.

Descriptors: *Sediment control, *Lake restoration, *Lake sediments, Sedimentation, Sediments, Dredging, Eutrophication, Phosphorus, Nutrients, Macrophytes, Aquatic plants, Cost analysis, Water quality.

Information on the effectiveness of sediment removal as a lake restoration technique is updated. Sediment removal is usually undertaken to deepen a lake and increase its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. In reviewing more than 60 projects and five case histories, it is revealed that the first three objectives are usually met through sediment removal. Dredging to control aquatic plants has not been well documented. Disadvantages of dredging include cost, temporary phosphorus release from sediment, increased phytoplankton productivity, noise, lake drawdown, temporary reduction in benthic fish food organisms, potential for toxic material release to the overlying water, and potential for environmental degradation at the dredged material disposal site. The technique is recommended for deepening and for long range reduction of phsophorus release from sediment. Sediment removal to control toxic materials is possible with minimal environmental impact when proper equipment s used, but it may more than double the cost. Lack of definitive information about rooted plant regrowth rates in dredged areas prohibits explicit recommendations on sediment removal to control plant growth. (Baker-FRC)
W82-06776

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,
West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.
For primary bibliographic entry see Field 5C.
W82-06777

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
For primary bibliographic entry see Field 6B.
W82-06778

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06789

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),
Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W82-06825

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,
Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W82-06827

EFFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,
Allahabad Univ. (India). Dept. of Chemistry.
For primary bibliographic entry see Field 4D.
W82-06834

STORMWATER MANAGEMENT IN A SENSITIVE AREA.
Public Works, Vol 113, No 7, p 67, July, 1982.

Descriptors: *Water management, *Saline water intrusion, *Storm water, Water quality management, Nutrient removal, Environmental effects, Jonathan's Landing, *Florida, Mangrove swamps, Water level, Storm wastewater.

The water management system at the 600-acre Jonathan's Landing, Florida, development has been called a model system. Major challenges in this golf-oriented, environmentally sensitive area were preserving the mangrove ecosystem, creating a 120-acre system of interconnecting fresh water lakes and tidal channels while preventing salt water intrusion, controlling storm water runoff pollutants, and preserving the esthetic appearance of the system. The water control structures include wells to manipulate fresh water levels, monitoring wells to detect shifts in the fresh water/salt water interface, and a broken tile filtration system to control nonpoint source pollution (nutrients and particulates removed by a system of grass swales). (Cassar-FRC)
W82-06841

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,

Plainville Water Co., CT.
L. E. Bordeau, and G. P. Fulton.
Public Works, Vol 113, No 7, p 72-73, July, 1982. 2 Fig.

Descriptors: *Water pollution treatment, *Organic compounds, *Wells, Groundwater pollution, Municipal water, Plainville, *Connecticut, *Chlorinated hydrocarbons, Industrial wastes, Water pollution sources, Fate of pollutants.

The Plainville Water Company, Connecticut, relying on two well fields, detected organic chemical pollution of its newer well field in 1975. Trichloroethylene levels were over 400 ppb; trichloroethane, 1000 ppb; and chloroform, 600 ppb. The source of the contamination, waste industrial solvent from an industrial park adjacent to the well field, was located and dumping stopped immediately. The aquifer was purged by pumping the more severely contaminated well to a waste collection area. Chloroform levels, used as an indicator, dropped to below 30 ppb by July 1975, below 10 ppb for most of 1976, and below 1 ppb by the middle of 1977. Levels of trichloroethylene and trichloroethane paralleled those of chloroform. (Cassar-FRC)
W82-06842

WATERTIGHT MANHOLES CUT INFLOW.
Public Works, Vol 113, No 7, p 52, July, 1982.

Descriptors: *Waterproofing, *Rehabilitation, *Sewer systems, Plastics, Infiltration, Manholes, Hitchcock, *Texas.

Sewer Guard water tight manhole inserts are being installed in the Hitchcock, Texas (population 6000) sewer system as part of a $8 mission wastewater system rehabilitation. The disk-shaped plastic inserts, resistant to corrosion and damage by sewer gas or road oils, form a virtually leakproof seal with the manhole frame. There are two self-cleaning relief valves. Sealed manholes effectively prevent inflow of storm water and debris. This is especially important in low-lying areas where water stands for some time after a storm. Groundwater infiltration is prevented by brushing two coats of waterproofing compound onto the manhole surface, starting at the top and working down to the invert shelf. (Cassar-FRC)
W82-06844

THE CHALLENGE OF UPGRADING ROADSIDE REST AREAS,
Iowa Dept. of Transportation, Ames.
H. Dolling.
Public works, Vol 113, No 7, p 50-51, July, 1982.

Descriptors: *Rehabilitation, *Recreation, *Roads, Sanitation, Highways, Wastewater treatment, Wastewater lagoons, Lagoons, *Iowa.

Iowa rehabilitated four pairs of the 19 and 1/2 pairs of rest areas on its interstate system during 1979-80. Originally built in 1966, the rest stops were inadequate for today's traffic. Costs for reconstruction were about $1 million for each pair of rest stops. Wastewater lagoon improvements at the first stop to be rehabilitated cost nearly $200,000. Some of the problems facing engineers were: poor surface drainage at the flat sites, freezing of wastewater transmission lines, and sidewalk heaving in the heavy clay soils. A grinder pump was installed to move recreation vehicle wastewater in one rest area. Some toilets were replaced with low water volume fixtures. Lagoon improvements were deferred until more funds are available. (Cassar-FRC)
W82-06845

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,
Hawaii Inst. of Marine Biology, Honolulu.
S. V. Smith, W. J. Kimmerer, E. A. Laws, R. W. Brock, and T. W. Walsh.
Pacific Science, Vol 35, No 4, p 279-395, October, 1981. 52 Fig, 51 Tab, 142 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, Marine biology, *Kaneohe Bay, *Hawaii, Diversion, Nutrient cycling, Phytoplankton, Zooplankton, Nitrogen, Phosphorus, Detritus, Heterotrophs, Benthos, Biomass, Water pollution effects, Subtropical regions, Bays, Nonpoint pollution sources, Fish, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Sediments, Lagoons, Reefs, Corals.

Domestic sewage secondary effluent entering Kaneohe bay, Hawaii, was diverted to the ocean in December 1977 (municipal) and May 1978 (Marine Corps) to study the responses of the ecosystem to sewage diversion. Nitrogen was the limiting nutrient. All of the inorganic N and most of the inorganic P added to the system were taken up biologically, mostly by phytoplankton. The rapid rate of nutrient cycling between the dissolved state, phytoplankton, zooplankton, microheterotrophs, and detritus supported a rate of productivity far exceeding the rate of nutrient loading. The nutrients reaching the benthos produced a large increase in detritivorous heterotrophs. The benthic community biomass was controlled by particulate loading. In the benthos the nutrients cycled among the dissolved state, heterotrophs, autotrophs, and the detritus. Eliminating the sewage input rapidly reduced biomass of plankton and benthos. Responses of variables to diversion fell into three groups: (1) moderate diversion and spatial responses (dissolved inorganic N, particulate organic carbon, phytoplankton biomass, phytoplankton growth rate, macroplankton dry weight, microplankton ash-free dry weight, lagoon floor N release, and extinction coefficient); (2) large diversion and wide range of spatial responses (dissolved inorganic P, hard bottom algal biomass, hard bottom cryptofaunal biomass, and lagoon floor biomass); and (3) little diversion and slight-to-large spatial responses (detritus, zooplankton, benthic algae and macrofauna, and fish). The benthic community did not return to the presewage state by the end of the study in August 1979, partly because some of the key organisms are long-lived and partly because nonpoint pollution sources continue to add sediment and runoff. (Cassar-FRC)
W82-06846

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,
Pittsburgh Univ., PA. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06881

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06892

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
E. Cover, and J. Wilhm.
Hydrobiologia, Vol 87, No 1, p 11-16, February, 1982. 3 Tab, 24 Ref.

Descriptors: *Destratification, *Lakes, *Metals, Manganese, Iron, Zinc, Heavy metals, Water sediments, Mixing, Ham's Lake, *Oklahoma, Benthic fauna, Accumulation, Bioaccumulation, Lake restoration, Fate of pollutants.

Water and sediment samples were collected from a destratified section and from a stratified arm of Ham's Lake, Oklahoma, in the spring, summer, and fall of 1978 and 1979. Total Mn in water was 38-119 micrograms per liter in spring and fall for both stratified and unstratified stations. However, in summer total Mn in water ranged from 109 to 5510 micrograms per liter, highest in the hypolimnion of the stratified arm. Soluble Mn comprised 8-65% of the total, average 28%. Mn in sediments ranged from 140 to 1562 micrograms per g with highest concentrations in summer and fall. Macroinvertebrates contained 39-1039 micrograms Mn per g, but variations between stations were not significant. Mean iron concentrations were: water (total Fe), 158-661 micrograms per liter; water (dissolved Fe), 16-176 micrograms per liter; sediments, 2-7 micrograms per g; and invertebrates, 544-6226 micrograms per g. Zn levels were very low in water (6-21 micrograms per liter) and sediments (0.5-1.4 micrograms per g). Concentration factors for Chaoborus punctipennis and Chironomus riparius were: Mn, less than 1; Fe, 1021 and 5111, respectively; Zn, 658 and 920, respectively. (Cassar-FRC)
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,
Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W82-06899

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,
Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
W. H. O. de Smet.
Hydrobiologia, Vol 87, No 2, p 171-189, 1982. 11 Fig, 10 Tab, 32 Ref.

Descriptors: *Ponds, *Aeration, *Midges, *Aerated lagoons, Oxidation, *Belgium,, Water pollution effects, Mud, *Phallus process.

An aeration system based on the principle of the water jet vacuum pump (Venturi system, Phallus process) was used to aerate a lowland brook-pond system polluted by organic waste. The effect of this aeration on immature chironomids was investigated. Forty-two species or species groups were found. A total of 224 samples were taken from 70 sampling stations. The changes in community composition, species richness, diversity, redundancy, abundance and biomass were studied in the light of the recovery after treatment. Before aeration started, chironomids were absent in the aeration basin. After 8.5 months of aeration a chironomid community characterized by low species richness (four species) and high redundancy was established. Prolonged aeration resulted in a further increase of the species diversity, and during the last survey, after about 2 years of aeration, the chironomid species richness had increased to 18 species. Similar trends could be found for the downstream sampling stations. The longitudinal recovery pattern probably restored the original zonation of the chironomid species, resulting from an ecological gradient created by the linear change in physiography of the water body. Orthocladiinae dominated in the brook stretch, whereas Chironominae and to a lesser extent Tanypodinae dominated in the ponds. (Baker-FRC)
W82-06912

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,
Belorussian State Univ., Minok (USSR).
For primary bibliographic entry see Field 5C.
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).

For primary bibliographic entry see Field 5C.
W82-06987

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 7, p 68-69, July, 1982. 1 Fig.

Descriptors: *Safety, *Personnel, *Accidents, Wastewater treatment, Education, Management, Attitudes, Williamsport, *Pennsylvania.

The Williamsport Sanitary Authority, Pennsylvania, established a safety program in 1980. The plan consisted of five basic components: (1) a review of common causes and types of wastewater accidents (obtained from experienced employees, reports at safety meetings, literature, correspondence, the accident file, and job site inspections), (2) promotion of a safety awareness effort (through the safety coordinator, bulletin board, safety meetings, and literature), (3) motivation of employee attitudes and participation (by bonuses, personnel evaluation, awards, photographs, safety meetings, literature, and memberships in safety organizations), (4) education and instruction of employees in safe work practices (by audiovisual material, drills, job site inspections, required reading and tests, good housekeeping, and safety meetings), and (5) acquisition and maintenance of safety equipment. The safety program, originated by management, has been taken over by the employees, who also organized existing safety notes into a 25-page booklet for distribution among workers. (Cassar-FRC)
W82-06992

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
J. Stedinger, D. Pei, and T. Cohn.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 508-511, June, 1982. 68 Ref.

Descriptors: *Literature reviews, *Systems analysis, *Water quality management, *Model studies, *Reviews, Monitoring, Water Pollution control, Wastewater treatment, Water reuse, Optimization, Nonpoint pollution sources, Planning, Water management, Water quality, Wastewater renovation.

Applications of systems analysis to water management were reviewed under several categories: water quality management, water quality assessment, pollution control, water quality modeling, and wastewater treatment and reuse. Water quality management topics concerned improvement of both public welfare and private profit through pollution control, methods for estimating stream assimilation capacities and waste load allocations, and effluent charges. Water quality assessment models were devised which linked pollution sources at the county level with major water bodies and which investigated the impact of energy production on water quality. Water quality control planning should consider all possible alternatives, marginal costs and benefits, seasonal variations in assimilative capacity, Nonpoint pollution sources, and use of reservoir releases. Water quality modeling methods were developed and improved with respect to urban storm water pollution, calibration and verification of models, proper sampling programs, phosphorus in lakes, and thermal and other discharges from powerplants. Models for wastewater treatment and reuse included a multilevel optimization model for multiobjective, multiprocess wastewater treatment problems, optimization of a 6-unit wastewater treatment plant subject to designated constraints, minimizing operations and maintenance costs, fault tree analysis for monitoring of small unattended plants, and water reuse planning. (Cassar-FRC).
W82-06997

ECONOMICS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
J. C. Hite, and R. K. McConnell.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 511-513, June, 1982. 19 Ref.

Descriptors: *Literature reviews, *Economic aspects, *Water quality management, *Cost-benefit analysis, Benefits, Urban runoff, Agriculture, Nonpoint pollution sources, *Reviews, Agricultural runoff, Taxes, Water pollution control.

Economists contributed a diverse body of information to the recent year's literature on water quality. Articles ranged from technical analysis of cost structure in water-using industries to studies on the effect of alternative pollution control policies on regional economies. Several studies concerned the economic aspects of nonpoint source pollution in agriculture and urban areas. Complex interrelationships between environmental quality regulations, farm price support and export policies, and farm income led to the conclusion that national policy on agricultural non-point-source pollution must be integrated with agricultural price and production policies to achieve success. Cost effectiveness, information and administrative costs, associated effects and acceptability of control options were considered for non-point-source pollution control in urban areas. Quantifying costs and benefits of water quality improvement was documented in several cases. Cost-effectiveness of meeting standards in wastewater systems, both municipal and industrial, was discussed. Several authors stated that economic incentives and pollution taxes are ineffective in water quality management. (Cassar-FRC)
W82-06998

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DEVELOPMENT OF MODELS FOR THE PLANNING OF LARGE-SCALE WATER-ENERGY SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
J. Matsumoto, L. W. Mays, and G. A. Rohlich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243395, Price codes: A15 in paper copy, A01 in microfiche. Technical Report CRWR-187, January 1982. 321 p, 34 Fig, 17 Tab, 37 Ref, 8 Append. OWRT B-231-TEX(2), 14-34-0001-0251.

Descriptors: *Energy, *Mathematical models, *Water demand, *Future planning, *Economic aspects, Fuel, Water use efficiency, Water requirements, Algorithms, Model testing, Forecasting, Prediction, Projections, Mathematical studies, Model studies.

A mathematical optimization model was developed to assist the investigation of various alternatives for future water-energy systems. The capacity expansion problem of water-energy systems considers future water-energy demands (for water, electricity, gas, coal) and the availability of water and coal, and requires the determination of the location, timing, and size of facilities to satisfy demands at minimum cost (including operating and capacity costs). The system consists of four subsystems (water, coal, electricity, and gas), the interactions of which are novelly expressed explicitly in mathematical terms and equations. Decomposition techniques are extensively applied because of the large scale nature of the problem. To accomplish this, an in-depth study was made of the mathematical structure of the problem. Benders decomposition was applied to the problem, decomposing it into a three-level problem: the capacity, production, and distribution sub-problems. These sub-problems were solved by the use of special algorithms: the generally upper-bounded, the simply upper-bounded, and the generalized network flow algorithms, respectively. Model uniqueness characteristics, major accomplishments towards solving the water-energy problem, comparisons with the other models, and suggested further work are described. (Zielinski-MAXIMA
W82-05915

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 4A.
W82-05925

MULTIOBJECTIVE RIVER BASIN PLANNING WITH QUALITATIVE CRITERIA,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
M. Gershon, L. Duckstein, and R. McAniff.
Water Resources Research Vol 18 No 2, p 193-202-, April, 1982. 4 Fig, 8 Tab, 21 Ref.

Descriptors: *Management planning, *Mathematical models, *River basin development, Water resources development, Resources development, Planning, Environmental impact, Resources management, Mathematical studies, Model studies, River basins, Water use, Semiarid climates.

The ELECTRE I and II methodologies were applied to multiobjective water problems in a semiarid environment. A multicriterion viewpoint was used to assess the impact of alternative river basin strategies on the Santa Cruz River in the vicinity of Tucson. Alternatives were ranked by the ELECTRE I method to obtain preference graphs to use as input into ELECTRE II. A complete ordering system based on quantifiable and nonquantifiable ordinal criteria was generated which allowed different weights to be assigned to different criteria to affect the outcome of results. In the case study presented, the preferred systems to solve water use conflicts of urban, agricultural, Indian and mining interests were reservoirs and channelization, while the least preferred solutions included areas of groundwater development. (Geiger-FRC)
W82-06062

A MULTIOBJECTIVE BRANCH-AND-BOUND METHOD FOR PLANNING WASTEWATER AND RESIDUAL MANAGEMENT SYSTEMS,
Kentucky Water Resources Research Inst., Lexington.
M. Nakamura, and S. M. Alexander.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243643, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 130, January 1982. 109 p, 21 Fig, 7 Tab, 136 Ref, 3 Append. OWRT A-083-KY(1). 14-34-0001-0119/1119.

Descriptors: *Multiobjective planning, *Algorithms, *Wastewater management, *Management planning, *Water costs, Planning, Mathematical studies, Optimization, System analysis, Mathematical analysis, Network design, Regional analysis, Regional planning, Numerical analysis, Wastewater, Mathematical equations.

A multi-objective branch-and-bound (BOB) algorithm method is proposed for use in analyzing multi-objective fixed-charge network-flow problems commonly found in water resources planning situations. A multi-objective imputed value analysis is also proposed, which makes use of the BOB tree-structure and allows comparison of the importance of facilities in the network. The imputed values obtained for a given problem provide information difficult to obtain efficiently using conventional mathematical optimization techniques. The method is capable of systematically and efficiently identifying a set of good planning alternatives. The method was applied to two hypothetical example problems dealing with regional wastewater treatment and residual management systems to demonstrate its potential usefulness. While the proposed method is designed to deal with network-flow structured problems, application of the BOB concept to general mult-objective planning analysis itself is appealing. The BOB tree can be extended to any desired set of objective cut-off values, and a set of noninferior solutions can be identified among the generated alternatives. The mathematical for-

mulation and the analysis procedure of the method was described. (Zielinski-MAXIMA)
W82-06149

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
J. L. Findeis, and N. K. Whittlesey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243718, Price codes: A12 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Report 44, May 1982. 257 p, 3 Fig, 77 Tab, 91 Ref, 6 Append. OWRT A-100-WASH(1), 14-34-001-9051.

Descriptors: *Model studies, *Input-output analysis, *Cost analysis, *Economic impact, *Irrigation requirements, *Hydroelectric power, Computer models, Mathematical models, Mathematical studies, Economic aspects, Economic evaluation, Water use, Electric power rates, Electric power costs, Thermal power, Irrigation, Irrigation water, Water demand, *Washington.

Research was carried out to analyze the competitive relationship between irrigation and hydropower uses of water, and to determine the impact of irrigation development on economy for the State of Washington. Estimations of irrigation and hydro-generation trade-offs were made using an updated version of the 1972 Washington State input-output model. Two irrigation projects were chosen for study, encompassing 796,000 acres. Undertaking both projects would yield an estimated additional agricultural output of $209 million/year (1972 prices), but substantially electrical losses for irrigation energy and energy lost through water diversions would occur. Replacing this power by thermal power would increase State wholesale electricity rates by as much as 43% above 1980 levels. Input-output analysis measured statewide impacts of simultaneous electricity rate and agricultural output impacts and assessed the distributional effects of additional irrigation. Even with higher electricity rates, State output, employment, and income will increase due to irrigation development, but distributional impacts will be significant. Undertaking both projects, residential electric bills will increase $11.36/person/year and certain industries will experience net residual income losses ($18 million/year for the aluminum industry alone at 1972 dollars. (Zielinski-MAXIMA)
W82-06156

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06175

RESERVOIR PLANNING FOR BRAZILIAN DAMS,
Brazilian National Committee on Large Dams; and Technical Commission on Dams and the Environment.
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 34, No 5, p 48-49, May, 1982.

Descriptors: *Multipurpose projects, *Reservoirs, *Water resources development, Planning, Brazil, Dams, Institutional constraints, Water law, Hydroelectric power, Developing countries.

Brazil's Codigo das Aguas, a collection of laws relevant to water resources, was compiled in 1934, before the industrial and population explosion and before large-scale water resources development. Pollution control regulations are still in an initial phase. Hydropower development is the responsibility of Electrobras, the federal holding company. Permits for construction of dams must be obtained from the Ministry of Mines and Energy. To date most reservoirs built in Brazil have been single-purpose. Little regional planning was done until 1979, when the federal government established a special committee on integrated watershed studies. This is responsible for regional planning and multipurpose development of streams and rivers. Increasing numbers of dam owners and designers favor multipurpose uses of reservoirs. Planning is done in three stages: (1) a baseline survey of hydrology, geology, biota, water quality, social impact, economic impact, etc., (2) appraisal of environmental effects, and (3) actual planning phase. (Cassar-FRC)
W82-06206

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 4A.
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
For primary bibliographic entry see Field 4A.
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06433

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,
Missouri Univ., Kansas City. Dept. of Geosciences.
S. E. Hasan, and T. R. West.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 117-132 1982. 7 Fig, 9 Tab, 15 Ref.

Descriptors: *Land use planning, *Geology, *Decision making, Maps, Planning, Computers, *Indiana, Waste disposal, Solid waste disposal, Septic tanks, Soil types, Bedrock, Soil classification, Erosion, Flood data, Water table, Permeability, Zoning, Data interpretation, Groundwater, Surface water, Networks, Data requirements.

A computerized data base for land use planning at the county level was developed using Boone County, Indiana, as the study area. The purpose of the work was to select the physical characteristics that best describe the land for planning purposes and to select the optimum size of the data cell. After the physical characteristics (or variables) were selected, the relative importance of each was evaluated. The subcategories of each variable were then ranked in order or importance. Computer processing assigned a weighting for each data point for a specific land use. The 23 variables included soil type, slope class, erosion class, flood potential, drainage class, depth to seasonal high water table, permeability, and agricultural productivity. A sample problem determined the suitability of a site for solid waste disposal. The solution was produced in the form of a computer generated map. The optimum cell size, dependent on the scale of the original data and the scope of planning, was 500 ft on a side for this study. The differences between results from smaller cells (250 and 100 ft on a side) were not great, but the data requirements of the smaller cells are much greater. (Cassar-FRC)
W82-06552

6B. Evaluation Process

WATER CONSERVATION INCENTIVES AND STRATEGY,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
For primary bibliographic entry see Field 3D.
W82-05906

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243338, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 142, June, 1982. 24 p, 17 Ref. OWRT A-059-IND(1).

Descriptors: *Irrigation economics, *Cost analysis, *Subsidies, *Arid areas, *Humid areas, Irrigation, Irrigation water, Public policy, Water policy, Corn.

The objectives of the research presented in the report was (1) to measure the marginal product of water in the production of corn in arid and humid regions of the United States and (2) to suggest implications of this analysis for public policy decisions in the future. The analysis involved estimations of production functions for irrigated corn in several states based upon agronomic data from experimental test plots. Alternative functional forms were examined and the three-halves polynomial function was selected to compare the marginal products among the states. The results indicated differences exist among states in the maginal product of water in corn production. Since these differences are not directly related to the areas where irrigation development has been publicly financed in contrast to privately supported, future public policy should take that into consideration. Policy options should include alternative subsidy programs for irrigation water supply systems, policies to influence the price of inputs other than water, policy to adjust the price of corn and elimination of all public support of irrigation development. The results of the analysis are limited by considerations of the marginal products of other crops and the marginal product of water in other uses. Neither of these issues were examined in this study because the research concentrated upon the single crop of corn which is grown and irrigated in many regions of the United States. (Author abstract)
W82-05909

HYDROELECTRIC POWER OFFERS STABLE, CHEAP ENERGY SOURCE FOR INDUSTRY,
Parsons, Brinckerhoff, Quade and Douglas, Inc., New York.
B. J. Van Weele, and E. M. McClung.
Pulp and Paper, Vol 56, No 2, p 114-115, February, 1982. 3 Fig.

Descriptors: *Hydroelectric power, *Pulp and paper industry, Economic aspects, Design criteria, Construction.

The pulp and paper industry is in a unique position to capitalize on hydropower, as many of the existing sites were selected and developed for this purpose by pulp and paper companies more than a century ago. Several economic considerations of hydropower development from the viewpoints of both new construction and the rehabilitation of abandoned sites are described. The best hydroelectric power plant sites tend to be located in forested areas with streams. The major advantage of a hydrosite to the developer is that it constitutes a long term energy source. Initial development cost may be high, but maintenance costs will be low, and the costs of energy production will rise less rapidly than the prices of energy from most other sources. The hydropower site also includes as advantages pollution free operation and no waste disposal problems. Four types of sites are likely to be candidates for hydropower development: existing sites with hydroelectric facilities that can be rehabilitated, existing sites with hydroelectric facilities that can be upgraded, sites where power generating capability can be added to existing hydraulic facilities, and new sites where full facilities can be constructed. With escalating electrical costs, small hydropower plants offer paper companies a viable means of reducing energy bills and, in many cases, can provide a source of revenue. (Baker-FRC)
W82-05954

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,
Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2, p 377-380, 387, March/April, 1982. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Economic analysis, *Irrigation, *Reservoir storage, Model studies, Crop yield, *Corn, Reservoir design, Soil water, Soil-water-plant relationships, Hydrologic models, Investment.

A method for determining optimum reservoir size, based on economics, was developed for a supplemental irrigation water supply. Crop yields were calculated for irrigated and nonirrigated conditions as well as daily irrigation water requirements using the Duncan-SIMAIZ model. The Haan Water Yield Model was used to calculate daily water yields into a water supply reservoir. The models were used with a reservoir water balance and present worth economics procedure to estimate the economics of investing in supplemental irrigation and to determine the optimum reservoir size. For a sample 100 acre farm planted with 30,000 corn plants per acre in a 300 acre watershed with specified infiltration rate, seepage rate, seepage/runoff ratio, soil moisture capacity, and irrigation management scheme a 40,000 cu m reservoir would produce a return on investment in 50% of the years if $13,000 or less were invested in the irrigation system (pipes, pumps, etc.). In humid areas the major benefits of irrigation would be evident in drought years only. This analysis can also be used to tell an investor the probability of recovering enough return on his investment in a given year to meet the payment on the system at a given interest rate. (Cassar-FRC)
W82-05966

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06059

IMPROVED PRINCIPLES, STANDARDS, AND PROCEDURES FOR EVALUATING FEDERAL WATER PROJECTS,
Wright Water Engineers, Inc., Denver, Co.
L. M. Eisel, G. D. Seinwill, and R. M. Wheeler, Jr.
Water Resources Research, Vol 18, No 2, p 203-210, April, 1982. 43 Ref.

Descriptors: *Water resources development, *Project planning, *Cost analysis, *Nonstructural alternatives, *Water conservation, Planning, Management planning, Economic aspects, Hydroelectric power, Navigation, Recreation, Flood damage, Evaluation.

Many attempts have been made to improve the evaluation criteria for Federal water resources development projects over the past forty years. With the advent of multiobjective planning formulated in the 1973 principles and standards adopted by the U. S. Water Resources Council, the scope of project evaluations has increased. The Council recently revised the 1973 principles and standards for recreation, hydropower, inland navigation, irrigation, flood damage and drainage and developed an auxiliary manual for evaluating the overall attractiveness of alternate plans for water resoruces development. Although these revised procedures for weighing the economic advantages and disadvantages of water resources development are more consistent with theoretical principles, in some cases they require compromises due to limited data, computational complexity, and legal and political constraints. Since the revised principles and standards stress nonstructural alternatives and water conservation, they are expected to be more responsive to the need for cost efficient and environmentally acceptable measures for water resources development. (Geiger-FRC).
W82-06063

RICE FIELDS OF SOUTH CAROLINA: A RESOURCE INVENTORY AND MANAGEMENT POLICY EVALUATION,
Clemson Univ., Columbia, SC. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
C. A. Gresham, and D. D. Hook.
Coastal Zone Management Journal, Vol 9, No 2, p 183-203, 1982. 2 Fig, 9 Tab, 5 Ref.

Descriptors: *Rice, *Water resources development, *South Carolina, Vegetation, Wetlands, Management, Regulations.

This report documents and discusses selected biological attributes and management considerations of the former rice fields of South Carolina. A brief historical background is presented, followed by an inventory made to determine the present biological and management status of the rice fields. State and federal legislation affecting the management of the rice fields is discussed to relate the biological and legal aspects of this resource. Sixteen vegetation cover types were recognized and described. Four types were considered to be managed types; seven types were dominated by marsh grasses and tree species. Of the three drainage system studied, one had a unique cover type composition. It differed from the other two due to flooding associated with the diversion of the Santee River in the 1930s. During the inventory of the drainage systems, 74,113 acres of former rice fields were located. The Waccamaw, Pee Dee, Black system contained 28,076 acres; the Santee system contained 25,456 acres; and the Wando, Cooper and Ashley system contained 20,572 acres. Owners of the former rice fields were managing the rice fields for waterfowl predominately, with snipe, sanctuary, and fish or seafood management clearly secondary. Only 32% of the former rice fields were under management. The owners also indicated that wildlife hunting and fiber production were the preferred future uses of the rice fields. Most of the former rice fields are wetlands under the definition of wetlands in Section 404 of CWA. Thus state and federal permit requirements complicate manipulation and management of former rice fields, which in turn practically prohibits scientific investigation of new compatible uses. (Baker-FRC)
W82-06072

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06170

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,
Illinois State Water Survey, Champaign.
S. A. Changnon, Jr., and R. G. Semonin.
Bulletin of the American Meteorological Society, Vol 63, No 4, p 399-406, April, 1982. 3 Fig, 21 Ref.

Descriptors: *Water resources development, *Weather modification, *Illinois, Artificial precipitation, Cloud seeding, Irrigation, Water supply, Water demand, Farming, Legal aspects, Water rights, Political aspects, Climatic data, Climates, *Climatology, *Weather.

The issues of climate change and prediction, inadvertent weather and climate modification, and planned weather modification are addressed as they relate to a comprehensive statewide water plan being completed in Illinois. The quality and quantity of water resources in that state are seen as irrevocably linked to and dependent upon the climate. Precipitation contributes all available water, even though much of it does not fall in the state but runs through it underground. Conflicts relating to climate result largely from the impacts of short term changes in climate extremes. These conflicts involve both local ones over water use and interagency assistance conflicts to determine who should receive aid. In cases of inadvertent weather modification, the conflict centers around determining who is at fault. The goal of state policy relating to inadvertent modifications is to understand the changes caused by Illinois and their impacts, and to establish policy positions and regulations regarding unfavorable modifications, for the benefit of the area and the nation. Planned weather modification offers a potential means to increase water supplies in Illinois. Farmers and agribusinesses have spent $0.5 million in the past five summers to support cloud seeding projects. Federal agencies have financed $7.8 million for research on weather modification in Illinois. Purposeful rainfall enhancement, if it can be done, has decided cost advantages over irrigation. Conflict in this area may center on moral, religious or environmental grounds. Interstate conflicts are also possible. To serve climate data and information needs a center with a real time access system is recommended. (Baker-FRC)
W82-06176

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,
Metropolitan Washington Council of Government, DC.
A. S. Librach, C. Wiegand, S. Freudberg, M. Sullivan, and R. N. Magill.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineering, Vol 108, No EE3, p 562-577, June, 1982. 9 Fig, 5 Ref.

Descriptors: *Estuaries, *Water resources development, Washington, District of Columbia, *Potomac River, Rivers, Water pollution control, Management, Water quality, Water pollution sources, Nonpoint pollution sources, Water quality management.

This paper presents an overview of the evolution of water quality management philosophy in the Washington, D.C., area, and describes an emerging approach to comprehensive water quality management. To define the problem, the total pollutant loadings to the Potomac Estuary from all sources are described. This is followed by an historical overview of water quality trends in the Estuary and the management response to perceived water quality problems. The estimated costs of providing increasingly higher levels of sewage treatment are then presented. Finally, the paper describes an evolving approach based on an analysis of tradeoffs between the various pollution control options available to determine the most cost effective and practical ways of achieving specific and realistic water quality goals. The new management approach evolving may replace the region's traditional and almost exclusive reliance on control of point source loadings to meet rigidly defined and interpreted water use definitions and quality standards. This new approach is more flexible and practical in the consideration of the impacts, controllability, and costs to control all loading sources. The approach would employ return frequency and economic considerations in tandem with sophisticated water quality model simulations to help identify the most cost-effective management solutions. To support a long term management strategy, a state of the art eutrophication model for the Potomac Estuary is being developed. (Baker-FRC)
W82-06361

WATER SUPPLY DEVELOPMENT IN THAILAND.
Water Services, Vol 84, No 1008, p S14-S16, S19, S20, February, 1980. 4 Fig, 2 Tab.

Descriptors: *Water supply development, *Planning, *Thailand, Water resources development, Water conveyance, Water supply.

It is estimated that the population of Thailand in 1977 was about 44,000,000, corresponding to an

average density of 85 persons per square kilometer. The Metropolitan Water Works Authority was founded in 1967 when the Thai Government combined the four municipal water authorities of Bangkok, Thonburi, Nonthaburi, and Samut Prakarn under the Ministry of Interior. The source of Bangkok's surface water is the Chao Phya River at Sam Lae, about 35 meters north of Bangkok. The water is relatively unpolluted and is above the reach of sea tides. Capital improvement programs and future work plans for the increasing population are reviewed. Water systems, construction programs, budgets and typical costs for water service in the rural areas are also noted. (Baker-FRC)
W82-06367

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.
Delaware Univ., Newark. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256611, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1982. 52 p, 10 Fig, 20 Ref. OWRT C-90191-G(9443)(1).

Descriptors: *Streams, *Environmental protection, *Public participation, *Public policy, *Public waters, Environmental impact statement, Environmental quality, Water quality control, Water quality, Valley springs, Valleys, Urban planning, Public opinion, Attitudes, Public lands, Land development, Storm runoff, Management planning.

The use of citizen panels was explored for interpreting technical information and for serving as intermediates between the unaffiliated public and institutions/governments, which hold the technical information. A Nominal Group Transaction mode is used to generate recommendations, and short-subject videotape movies are used as a communication device in a process for enhancing public participation in protecting/improving a stream valley environment. The results of this study are presented as a prototype for general application. The White Clay Creek Valley functioned as a study case area, with several recommendations being developed for application to stream valleys. These are that: the stream proposals evaluated for potential adverse environmental impacts; the stream valley core should be reserved for low-intensity uses (recreation, nature preserves, woodlands); a planning program for conservation/management practices should be established to treat streams of different order; and that a citizen's council should be established to monitor/inform/serve the public interest in the watershed on important issues (e.g., future development, stormwater management, maintaining biological diversity, recreation). (Zielinski-MAXIMA)
W82-06368

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,
Texas Water Resources Inst. College Station.
For primary bibliographic entry see Field 3F.
W82-06374

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,
North Yorkshire County Council (England).
P. Lawson.
Hydrobiologia, Vol 88, No 1-2, p 19-26, March, 1982. 6 Ref.

Descriptors: *Economic aspects, Evaluation, *Prediction, *Reservoirs, *Water demand, Cost analysis, Water rates, Economic evaluation, Economic prediction, Public policy, Projections, Forecasting, Growth rates, Economic justification, Water supply, Rutland Water, England.

Arguments for and against reservoir development in Rutland, United Kingdom, are presented. The process of decision-making which took place in the mid-1960s highlighted basic conflicts between urban expansion and rural agriculture. Debate at the local level and in Parliament raised issues which are still unresolved. Because the Rutland Water scheme involved changing the course of a river, the consent of Parliament was required. Local objections concerned land use disruption, effects on the local economy, landscape impact, and drawdown effects. Arguments for the project were that per capita consumption of water was expected to increase, existing water sources were overextended, and no alterntives were available as short-term solutions. (Titus-FRC)
W82-06480

INTRODUCTION - RUTLAND WATER 1970-1981,
Leicester Univ. (England), Dept. of Adult Education.
D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 1-5, March, 1982. 4 Fig, 9 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, Evaluation, *Project planning, Water supply, Water demand, Public opinion, Public policy, Water policy, Construction, *Rutland Water, England.

Rutland Water (Empingham Reservoir) was officially established in May 1970 by the Mid-Northamptonshire Water Act. Within 10 years, the completed reservoir had reached its top water level and the dam had been inspected; about half its design capacity was being used for water supply and it had received national acclaim for its wildfowl populations. The Rutland Water Research Group sponsored a conference to review the changes associated with the reservoir in its first decade. The controversy which arose during the planning of this pumped-storage reservoir, primarily due to its size and location, still exists despite the success of its recreational provisions and water supply management. (Titus-FRC)
W82-06482

FACT FINDING HEARING - COTTONWOOD CREEK INSTREAM BENEFICIAL USE PROGRAM,
California Regional Water Quality Control Board, Sacramento.
Staff report, June 1982. 150 p, 5 Fig, 10 Tab, 42 Ref, 5 Append.

Descriptors: *Streams, *Rivers, *Beneficial use, *Water quality management, *Water permits, *Public hearings, Water policy, Water rights, Water supply, Water temperature, Fisheries, Recreation demand, Wildlife management.

The California State Water Resources Control Board's responsibilities include issuing water rights applications and permits in an effort to protect the public interest and to mitigate adverse environmental impacts. Both quality and quantity determine the amount of water to be left in a source to protect instream beneficial uses. The primary instream beneficial uses of the Cottonwood Creek System, which includes part of the Sacramento River, are recreation (boating/fishing) and fisheries. This report presents three options comprising seven alternatives for the system's instream use management. The alternatives are: 1) to maintain the existing levels of instream beneficial uses in both systems, but with temperature and turbidity/siltation controls; 2) to maintain reduced levels of instream uses in both systems, i.e., 50% of the total present salmon fishery, 97% of the present recreation at Cottonwood and 75% at Sacramento; 3) to maintain 50% of the present salmon fishery at Cottonwood and existing levels of instream use at Sacramento; 4) to maintain current levels of instream uses at Cottonwood and decrease levels at Sacramento; 5) to maintain instream uses at Cottonwood and increase fishery and recreation levels at Sacramento; 6) to increase Cottonwood's instream uses and maintain existing instream uses at Sacramento. Alternative 7, the recommended program, includes water temperature control, stream channel/streambank protection, best management practices to control nonpoint sources of pollution, and gravel cleaning and replenishment. The above objectives would be implemented by federal, state and local agencies. (Atkins-Omniplan)
W82-06522

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2E.
W82-06523

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,
Nevada Univ. System, Reno. Desert Research Inst.
R. C. Broadbent, S. C. Weaver, J. W. Fordham, and G. F. Cochran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256702, Price codes: A06 in paper copy, A01 in microfiche. Publication No. 41074, January 1982. 132 p, 61 Fig, 14 Tab, 39 Ref. OWRT B-104-NEV(1), 14-34-0001-8099.

Descriptors: *Artificial recharge, *Aquifer management, *Water resources development, *Surface-groundwater relationships, *Mathematical models, Aquifer systems, Aquifer testing, Rivers, Planning, Forecasting, Water loss, Water costs, Economic aspects, Computer models, Mathematical studies, Model studies, Groundwater availability, *Colorado River, *Nevada.

Study was undertaken to assess whether and how southern Nevada can take maximum advantage of excess Colorado Rriver (CR) diversion capacity that is expected to exist over the next 20 years through the southern Nevada water supply system. Analysis of the water resource system defined a range of potential groundwater(GW)-surface water management scenarios defined by the resource system model. Chemical equilibria calculations and sediment-water mixing experiments were also conducted. The study results led to conclusions that: the apparent least-cost management strategy is to continue GW pumping at the current rate without salvaging lost CR water, but failure to build a water reserve for future use and the problems inducible by such failure may make this strategy undesirable; artificial recharge of CR water is technically feasible but probably undesirable economically; reduction in current total GW pumpage to 40,000-45,000 acre/foot/year would permit salvage of CR water by maximizing its use and allowing GW reservoir replenishment, however reduced GW pumpage would induce higher water costs. (Zielinski-MAXIMA)
W82-06694

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,
Missouri Water Resources Research Center, Columbia.
J. M. Sharp, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256728, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 27 p, 4 Fig, 4 Tab, 26 Ref. OWRT A-129-MO(2), 14-34-0001-0127.

Descriptors: *Alluvial aquifers, *Alluvium, *Computer models, *Hydraulic properties, *Water exchange, Water resources development, Computer programs, Model studies, Mathematical studies, Mathematical models, Surface water, Flow discharge, Water storage, Induced infiltration, Recharge basins, Instream flow, Consumptive use, *Missouri River.

Research was conducted: to estimate the water resources potential of the lower Missouri River Valley alluvial aquifer (AA) from Rulo, Nebraska to St. Charles, Missouri; to provide mechanisms for improving hydraulic property estimates of the AA; and to ascertain the problem or future problem potential regarding the AA and associated surface waters. Drill hole and pump test data for the AA were re-evaluated. Flow rates of the Mis-

souri River and its major tributaries in the study area were tabulated. A flow-storage-recharge-pumping model (consisting of about 50 submodels, each covering about 10 miles of the 498 mile AA length) was developed for conjunctive use of the stream/aquifer system. Qualitative assessment was made of instream flow problems of the lower Missouri River system. It was concluded that: better data are needed on groundwater/river interactions and stream channel changes; that water use data are highly variable, making accurate projections of Missouri water demands presently impossible; that, due to local demands and projected upstream dimensions and consumptive use, water resources of the lower River AA system are deemed as potentially critical. New determinations of stream-flow needs for lower River fish/wildlife will offer a constraint on available groundwater in the Alluvium. Detailed analyses of river-aquifer water exchange indicate local inhomogeneities control the near river response patterns. (Zielinski-MAXIMA)
W82-06696

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
H. J. Vaux. Jr., and M. Neiman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256744, Price codes: A03 in paper copy, A01 in microfiche. Water Report, September, Davis, Calif. 1980, 22 p, 2 Tab.

Descriptors: *Institutional constraints, *Groundwater management, *California, *Economic aspects, *Model studies, Water management, Groundwater basins, Institutions, Water law, Legal aspects, Feasibility studies, Public participation, Hydrologic systems, Mathematical models, Cost-benefit analysis, Future planning, Estimated benefits, Surface water availability.

The effectiveness of existing groundwater management institutions, using economic models and institutioal analysis to identify alternative institutional arrangements and their feasibility, was examined. Using existing groundwater basins, a sensitivity analysis assessed the change in economic incentive with a change in various parameters (e.g., discount rate; surface water availability). It was concluded that California water institutions/laws developed in a period having characteristics differing sharply from California's current groundwater situation. Further, Californians have preferred supply-augmenting solutions involving broad public participation, often being economically inefficient. New water management institutions cannot be expected to operate effectively unless they are designed to at least partially accomodate prevailing public attitudes/preferences, existing hydrologic and engineering of current water supply systems, and the perception that economic efficiency is not always paramount. Analysis of the southern San Joaquin indicated that in the absence of supplemental supplies, groundwater management may still be justified in economic grounds, provided such management costs are modest. A revised institutional structure will be needed to meet future groundwater demands. A dynamic optimization model is described which was used to establish the existence of net benefits from groundwater management, (Zielinski-MAXIMA)
W82-06700

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,
George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
D. P. Beard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256785, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center, Washington, DC., Report No 36, February 1982. 183 p, 26 Fig, 67 Ref, 8 append. OWRT A-016-DC(1).

Descriptors: *Water supply, *District of Columbia, *Management planning, *Institutional constraints, *Regional planning, Water costs, User charges, Water shortage, Available water, Urban planning, Planning, Future planning, Drought, Water deficit, Economic aspects, River basins, Evaluation, Water resources development, Water requirements.

The water supply management structure and its operation are described for the District of Columbia, as well as the issue it will face in the 1980's and how the District is prepared to deal with these issues. These issues include: adequacy of future water supplies; regional cooperation; water supply emergency and drought management; water supply system rehabilitation; water billing/collection; and rate increases and conservation pricing. Major emphasis is given to detailed definition of the Potomac River basin, the legal and institutional management of the River, the overall water supply network in the Washington metropolitan region, and the water supply management functions in the District. The District water supply was found to be reliable, inexpensive and of good quality. Other than some administrative concerns (e.g., billing/collection), the District water management system performs adequately. Recent studies do not forecast water supply shortages, and regional cooperation appears to be improving. However, while the water supply future in the District area appears optimistic, caution is urged to ensure continued and improved cooperation as a critical factor in meeting future water supply needs. (Zielinski-MAXIMA)
W82-06704

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,
Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
A. O. Esogbue, and Z. M. Ahipo.
Water Resources Bulletin, Vol 18, No 3, p 451-456, June, 1982. 4 Fig, 11 Ref. OWRT B-147-GA.

Descriptors: *Water resources development, *Planning, *Public participation, Public relations, Nonpoint pollution sources, Pollution load, Attitudes, Social participation, Future planning, *Fuzzy sets, *Model studies, Mathematical studies, Algorithms.

An effort to apply the technique of fuzzy set modeling to an important problem in an areawide based approach to managing a scarce and diminishing natural resources is reported. Research in nonpoint water pollution control planning via fuzzy sets is aimed at planning under uncertainty and in a fuzzy environment, especially with respect to fuzzy goals/objectives and enforcement problems; to the scientific determination of best management practices (BMP's); to measure the effectiveness of BMP's as control procedures for nonpoint source pollution; and to measure and improve the effectiveness of public participation in water resources planning from a quality viewpoint. Specifically, a fuzzy set model is developed for quantifying and measuring the effectiveness of public participation. The model is essentially cascade in nature and employes the concepts of fuzzy pessimistic and optimistic aggregation to cluster and analyze the evaluations of the basic factors. Sample computations of the model are provided. (Baker-FRC)
W82-06778

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
M. V. Martin, and L. M. Arthur.
Water Resources Bulletin, Vol 18, No 3, p 481-484, June, 1982. 1 Fig, 13 Ref.

Descriptors: *Inland waterways, *Navigation, Planning, Canals, Navigable rivers, Waterways, Feasibility studies, Financial feasibility, Cost-benefit analysis, Bonneville Lock, Columbia River, *Oregon.

One cause of delays in projects to develop inland waterway transportation is a lack of analytical credibility associated with the project. This was examined in connection with the proposal to construct a new, expanded lock at the Bonneville Dam on the Columbia River. At present commercial waterborne transport extends 465 miles upriver and accommodates barges of up to 3,200 tons capacity. Between 1938 and 1975 eight locks were built on the Snake-Columbia system, primarily as co-serve facilities with hydroelectric dams, but the lock system has also contributed to irrigation of cropland. Therefore, any proposed changes must consider all these aspects as well. In evaluating the benefits and costs of a proposed waterway project, two scenarios must be compared: projected economic development with the project vs. development expected to occur without the project. By following a carefully defined set of analytical guidelines, specific enough to ensure consistency and completeness, yet flexible in application, it is hoped that some of the delays currently caused by a lack of definitive project analyses will be diminished. (Baker-FRC)
W82-06869

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COUNT ON UNCLE SAM LESS,
Office of the Secretary of the Army, Washington, DC.
W. R. Gianelli.
Civil Engineering (New York), Vol 52, No 4, p 49-52, April, 1982. 3 Fig.

Descriptors: Water resources development, *Planning, Design criteria, Financial aspects, *Government finance, *Government supports, Economic aspects, Federal jurisdiction, *Political aspects.

Under the present federal budget crunch, old ways of managing water resources projects will no longer work. New directions are needed which will call for increased participation of other sectors in planning, cost-sharing, and financing proposed federal water projects. Estimates suggest that as much as $20 billion could be invested in the coming decade for potential water projects, including areas such as navigation, flood damage reduction, hydropower, and municipal and industrial water supplies. The number of new federal project construction starts has decreased steadily over the past few years. The Administration plans to identify what the federal role in various water projects should be. One key feature is the establishing of national economic development output of proposed projects. Water projects with only local or regional beneficiaries may not qualify as they have in the past for federal financing. However, federal expertise in the planning and construction of water projects may continue to be available. One way to assure that the planning process concentrates on those projects with the highest likelihood of being implemented is for project sponsors to participate in study financing. It is proposed that the new Corps of Engineers studies be done in two stages. The federally financed reconnaissance stage would require 12-18 months, with the subsequent feasibility stage being cost-shared 50/50 with the federal government and another project sponsor. (Baker-FRC)
W82-05998

COST OF WASH HOUSES AND COMFORT STATIONS AT RECREATION AREAS,
Army Engineers Waterways Experiment Station, Vicksburg, MS.
A. K. Lindsey, and T. M. Walski.
Water Resources Bulletin, Vol 18, No 2, p 331-334, April, 1982. 3 Fig, 4 Ref.

Descriptors: *Recreation wastes, *Sanitary engineering, *Costs, Estimated costs.

Cost functions are presented for comparison of different types of sanitary facilities (vault toilets, wash houses, and comfort stations) built at water resources projects. Functions for exterior costs are computed for plywood siding with asphalt or cedar shingles, concrete masonry units with asphalt or cedar shingles, concrete masonry units

with brick veneer and asphalt shingles, concrete units with brick veneer and cedar shingles, and cedar siding with cedar shingles. Interior cost functions are given according to type and number of toilets and fixtures. An equation for total construction costs includes exterior and interior costs, the elaborateness of design, and an allowance for inflation. Area of the building may be determined by an equation which includes number and type of fixtures and a spaciousness factor. An example is given in which the type and cost estimates for a wash house are prepared. (Cassar-FRC)
W82-06042

HOW EQUITABLE ARE EFFLUENT CHARGES,
Furness (C. D.) and Associates Ltd. (England).
C. D. Furness.
Effluent and Water Treatment Journal, Vol 22, No 3, p 99-100, 102-103, March, 1982. 5 Tab, 8 Ref.

Descriptors: *Effluent charges, *Effluent limitations, *Industrial wastes, *Mathematical studies, Accounting, Pollution taxes, Water quality standards, Effluents, Cost allocation, Cost sharing, Water quality management.

Evidence is given to substantiate the contention that the apportioning of the costing elements in the Mogden-type charging formula for effluent discharges which has been used in Great Britain since 1974 is imprecise and therefore unequitable. Figures are given to illustrate that there are significant variations in the total charges imposed on industrial dischargers by the Regional Water Authorities for the reception and treatment of their regional average strength effluents. Thus these charges do not provide a true basis for comparison. Comparisons have been attempted by calculating the charges levied by each authority for the reception and treatment of a fixed weight of pollutant when contained in the relevant volume of regional average-strength effluent for a particular region. Another method of comparing the charges levied by each authority is unit costing of a given weight of water or pollutant received for treatment. Charges for COD, BOD, and the solids strength of the effluent are still used by many water authorities. It was concluded that an increased degree of uniformity with respect to the assessment of polluting strengths and the apportionment of the charging elements would remove any anomalies in the charges imposed and ensure more equitable charging in the future. (Geiger-FRC)
W82-06074

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,
Illinois Dept. of Energy and Natural Resources, Chicago.
For primary bibliographic entry see Field 5F.
W82-06098

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12
Huff and Huff, Inc, Chicago, IL.
For primary bibliographic entry see Field 5G.
W82-06099

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,
Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
For primary bibliographic entry see Field 5G.
W82-06207

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,
Stanley Consultants, Inc., Muscatine, IA.
R. H. Stanley, and R. L. Luiken.
Public Works, Vol 113, No 5, p 70-73, 116, May, 1982. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Water rates, *Water costs, *Peak demand, Water metering, Utilities, Prices.

Utility rate structures should encourage conservation, efficiency, and equitable rates. The rate system should also produce a stable revenue for the company. The rate making process consists of several major steps: determine revenue requirements for the selected year, allocate the cost of service to each rate class, and design rates consistent with the results of costs of service analyses. The cost of service methodology involves three major steps: arrange investments and operating costs into major divisions such as supply, treatment, fire protection, etc.; determine appropriate customer, demand, and commodity allocation factors for each rate class; and allocate costs to each rate class. This procedure is illustrated in detail. Allocation of demand-related costs to the different rate classes is important and difficult. The American Water Works Association Base-Extra Capacity methodology is recommended for this. The rate structure for each class should produce revenues matching the overall cost of service for that class. In general, seasonal and ratchet rates result in more equitable charges than the traditional annual rate approach. They are also effective in reducing peak day and peak hour demands. However, the seasonal and ratchet rates result in less revenue stability because they are more dependent on weather and customer summer usage habits. It is predicted that in the future there will be greater use of seasonal rates, fewer declining blocks and less price differential between blocks, and recovery of customer-related costs by separate customer or service charges. (Cassar-FRC)
W82-06222

STATISTICAL COST FUNCTION FOR WATER MAINS,
Canadian Department of Supply and Services, Ottawa, Ontario. Bureau of Management Consulting.
B. M. Firestone.
Water/Engineering and Management, Vol 129, No 5, p 50-52, May, 1982. 4 Ref.

Descriptors: *Cost analysis, *Water mains, Mathematical equations, Planning, Statistical analysis, Mathematical studies, Installation, Water conveyance, Pipelines.

A statistical function relating costs and flow volumes is needed for a determination of optimal pipe diameters when planning for water main installation. Such a function will help avoid the installation of excessive capacity and unnecessarily high costs. Premature duplication of water mains and unnecessary disruption will also be avoided. The ratio of pipe cost per unit length to flow will decrease as capacity or flow increases. The existence of a 'two-thirds rule' has been suggested - costs rise as the two-thirds power of output capacity. this rule is used by engineers in estimating the cost of new process equipment. In this paper the hypothesis suggests that total in situ pipe costs per unit length (TC) can be expressed as a function of flow capacity (Q) and length of section laid (L). An equation is suggested, and data derived from melbourne and the Metropolitan Board of Works records is used to demonstrate its effectiveness. The findings suggest that set-up costs act as a fixed cost, invariant with pipe diameter or the length of section laid. A decrease in predicted replacement costs per mile noted, which also results from short sections commonly being laid in developed areas where main laying costs are very high. Thus longer sections will show a lower cost per mile. To estimate increasing returns to scale with flow, the confounding influence of length of section laid must be removed. The conclusion is drawn that efforts should be directed toward laying the longest possible continuous section lengths at any one time. Planners should also consider the substantial scale economies existing with respect to flow when determining optimal pipe sizes. (Baker-FRC)
W82-06252

WATER UTILITY COSTS AND RATE DESIGN FOR FIRE PROTECTION SERVICES,
CH2M/Hill, Portland, OR.
C. W. Corssmit, and D. D. Green.
Journal of the American Water Works Association, Vol 74, No 6, p 270-277, June, 1982. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Pricing, *Water users, Economic aspects, Alaska, Fire protection, Water rates, Water demand.

A 1981 cost-of-service analysis was made of water and fire flow demands. Rates for water provided by Central Alaska Utilities for fire protection were based on data from that study. Fire protection costs were then allocated to all water system users, who are charged for each block of fire flow demand required to protect their properties. In order to design such a system the database used must be significantly comprehensive to enable the identification of annual revenue requirements by appropriate cost functions. The capacity cost method provides some important advantages over the incremental cost method. All functions of the system are treated on an equal basis for cost allocations, and there is no need to declare primary versus secondary purposes. Incremental cost calculations, which can be cumbersome when multiple cost functions are involved for a number of utility components, are not needed. Finally, the capacity cost method conforms with the base extra capacity cost allocation method that is used to delineate both the capital and the operation and maintenance costs and therefore all demand data can be used on a coincidental demand basis. The advantages and disadvantages of several alternatives are described. (Baker-FRC)
W82-06275

WATER RATES AND RESIDENTIAL WATER CONSERVATION,
National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 3D.
W82-06276

COST-BASED WATER RATE DESIGN,
Norville (Rodney L.) and Co., Houston, TX.
R. B. Matthews, and S. Webster.
Journal of the American Water Works Association, Vol 74, No 6, p 282-284, June, 1982. 3 Tab.

Descriptors: *Water use, *Pricing, Conservation, *Water rates, Economic aspects, Water conservation, *Cost-based water rates.

In order to finance major capital expenditures needed for improvements to water systems, some manner of making the necessary rate increases more palatable to the public must be found. Often the solution may be the use of a cost based rate design as an alternative to the traditional declining block rate structure. A system of rate structures that more clearly links the cost of meeting demands with the customers who impose the peak requirements appears to be a positive approach. Such a rate structure requires a definition of peaking characteristics and of groups of customers with similar peaking characteristics. Among residential customers in both single-family and multifamily dwellings, peaking intensifies as consumption increases. Once water use reaches a sufficient level to meet basic consumption and housekeeping needs, additional consumption results from discretionary intermittent water consumption. Among industrial and commercial customers, peaking decreases as consumption increases. If cost based rates are the objective of rate structures, the first step in implementation is to acquire data to define the relevant classes of customers. Cost based rate design is not a conservation rate in the sense of implying conscious bias in rate design against large volume users. It is based only on an objective cost of service analysis. The only change from traditional practices is a redefined customer classification scheme. A cost based rate structure effectively correlates cost with the individual customer who has the ability to pay. The retention of declining rate blocks for commercial and industrial customers eliminates the lack of incentive for industrial and commercial development inherent in many rate structures that seek to motivate water conservation. (Baker-FRC)
W82-06277

STATISTICAL SAMPLING TECHNIQUE FOR CONTROLLING THE ACCURACY OF SMALL WATER METERS,
Hackensack Water Co., Harrington Park, NJ.
P. Tao.
Journal of the American Water Works Association, Vol 74, No 6, p 296-304, June, 1982. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Water metering, *Measuring instruments, *Statistical methods, Maintenance.

Through the use of a statistical sampling program based on random sampling theory, drawbacks associated with the periodic age change program for water meters can be corrected. The two drawbacks associated with the periodic age change program for meters are that more than 90% of the meters repaired under the periodic age change program are still serviceable, and therefore the cost of unnecessary meter repair imposes a burden on the water utility and its customers, and second, once the meters are set on the customers' premises, no regular program is undertaken to check the accuracy of the meters until the next age repair. The statistical sampling scheme, as a substitute for the periodic meter age change program, will solve these problems. Such a program proposed for Hackensak, New Jersey, will reduce the number of meter changes and repairs by 6000 per year at a saving of $94,000, based on 1977 costs. A further effect of the proposed program will be to reduce unaccounted for water by a small percentage., The core of the program is the design phase and making the decision as to whether to accept the premise that 70% of the meters or more are accurate and 10% or less of the meters are fast. This meter sampling program went into effect in 1980. The program will be re-evaluated in 1983, but at the moment the results appear promising, and it is felt that statistical sampling will successfully replace the 15-year meter change program. (Baker-FRC)
W82-06350

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,
Florida Univ., Gainesville. Dept. of Food and Resources Economics.
D. Comer, and R. Beilock.
Journal of the American Water Works Association, Vol 74, No 6, p 285-287, June, 1982. 2 Tab, 3 Ref.

Descriptors: *Water conservation, *Pricing, Water users, Water rates, Economic aspects, Conservation.

Decision makers must analyze the implications of alternative rate structure devices carefully, with respect both to the projected results from implementing a new rate structure and to the sensitivity of those results to the underlying assumptions that are made to generate the projections. Decision makers need to examine the implications of alternative pricing structures by varying the underlying assumptions so that a range of projections from which to choose a new rate structure is available. The sensitivity of the results of a declining rate structure to changes in the accompanying underlying assumptions is examined. The example considered was used to demonstrate how a declining rate structure can be more effective in conserving water than either an inclining or a single rate structure. Three assumptions are crucial to the results of this method. First, the revenues collected cannot be greater than the revenues needed. The second asssumption concerns the relative sizes of the high- and low-use groups. For water conservation purposes, a declining rate structure becomes less effective as the high use groups become larger in relation to the low use groups. When a pricing system is designed to promote consumption by one group relative to another, the larger the group enjoying lower prices, the greater will be total consumption. The third assumption concerns the relative price elasticities between the groups. The absolute value of the elasticity indicates the responsiveness of quantity demanded to a change in price, and the sign of the elasticity indicates the type of response that occurs. (Baker-FRC)
W82-06351

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06382

CRISIS: FINANCING WATER AND WASTEWATER,
Thames Water Authority, London (England).
E. J. Gilliland, and S. H. Hanke.
Water/Engineering and Management, Vol 129, No 7, p 41-43, June, 1982. 4 Ref.

Descriptors: *Financing, *Accounting, *Depreciation, *Water treatment, *Wastewater treatment, Economic aspects, Capital, Water rates, Pricing, Grants, Loans, User charges.

Developments in financing water and wastewater treatment are discussed. Four methods of financing capital investments are available: contributions by new customers (connection charges, etc.), government grants, loans, and self-financing. The preponderance of external financig over self-financing has produced several effects on the utilities' financial policies: inadequate charges, dependence on bond issues, favoring low capital cost outlays which may entail higher long-term operating costs, inhibitation of capital investments, and inadequate cash for replacement. To remedy these problems depreciation charges on the current written-down value of assets should be included. The problems of inflation, replacement or rehabilitation of aging assets, and shortage of capital has led to some recommendations by groups in Australia and the United Kingdom. Basically, they call for depreciation on the current cost basis, increased self-financing, more realistic charges for use, integration of financial planning in the management process, and a uniform cost accounting practice. (Cassar-FRC)
W82-06641

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,
Denver Research Inst., CO.
For primary bibliographic entry see Field 3C.
W82-06693

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06796

METHODS FOR APPORTIONING THE COST OF A WATER RESOURCE PROJECT,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. P. Heaney, and R. E. Dickinson.
Water Resources Research, Vol 18, No 3, p 476-482, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: Water resources projects, *Cost allocation, *Pricing, Economic aspects, Cost analysis, Costs, Model studies, Mathematical studies, Mathematical equations, Game theory, Tennessee Valley Authority.

Existing methods for examining the problem of apportioning costs among project participants in a fair manner are reviewed. Concepts from cooperative n-person game theory are offered as providing a unified conceptual framework for doing these analyses. Finally, a new method, the minimum costs, remaining savings (MCRS) method is proposed as an improvement over existing techniques. The MCRS method can be viewed as a generalization of the presently used separable costs, remaining benefits method. (Baker-FRC)
W82-06853

COST ALLOCATION IN WATER RESOURCES DEVELOPMENT,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
H. P. Young, N. Okada, and T. Hashimoto.
Water Resources Research, Vol 18, No 3, p 463-475, June, 1982. 3 Fig, 10 Tab, 31 Ref.

Descriptors: *Water resources development, *Cost allocation, Pricing, Economic aspects, Cost analysis, Costs, Mathematical studies, Mathematical equations, Multipurpose reservoirs, Game theory, Sweden.

It is necessary to choose rationally among the many different methods of allocating the costs of a joint water resource facility among the different area users. Using a definite computational procedure itself provides some semblance of rationality. However, the justification of a method lies in its behavior in practice, and it is thus necessary to compare the different methods on the basis of principle. Among the most important of these principles are individual rationality, group rationality, insensitivity to the definition of direct costs, monotonicity in costs, and no payments to dummies. A more general principle is simplicity in terms of computational and informational demands. Game theory methods all suffer from the disadvantage that they are fairly complicated and require detailed information on costs. All the methods except for the simplest proportional allocation schemes rely on information about demands and the optimal scale of development that in practice may be unreliable or nonexistent. This is particularly true for long term investment projects. It is therefore not surprising to find that a simple scheme based on allocating costs in proportion to the population was the one actually chosen. (Baker-FRC)
W82-06854

6D. Water Demand

THE ENERGY RESOURCES OF KENYA,
Ewbank and Partners Ltd., Brighton (England).
P. W. Fielder, and T. W. Berrie.
International Water Power and Dam Construction, Vol 4, No 4, p 39-41, April, 1982. 4 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Economic aspects, Hydroelectric plants, Powerplants, Electric power, *Kenya, South Africa, Developing countries, Regional development, Energy.

In attempting to meet the high cost of imported fossil fuels, Kenya is trying to develop its local energy sources such as hydropower, as well as strengthen the interconnecting links with surrounding countries. Commercial energy consumption in Kenya is below that for the average low-income countries, but its energy imports as a percentage of merchandise exports are high, due to the very high cost of oil imports. The main indigenous energy resource is hydroelectric power with a potential of about 5500 MW. About half of this is scattered among small rivers, many of which are economically exploitable. The main source of hydroelectric power is the Tana River. The main thermal station, Kipevu, is on the coast of Mombasa. There are diesel plants at Nairobi and other load centers with gas turbines for peaking at both Mombassa and Nairobi. The most important factor for ensuring optimum generation is making the best use of the Tana River flow which is a function of rainfall patterns. (Baker-FRC)
W82-05978

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.

For primary bibliographic entry see Field 3B.
W82-06136

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
J. A. Ziegler, and S. E. Bell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243759, Price codes: A05 in paper copy, A01 in microfiche. Publication No 85, September 1981. 86 p, 17 Tab, 81 Ref. OWRT A-048-ARK(1), 14-34-0001-9999.

Descriptors: *Cost analysis, *Water demand, *Industrial water, *Estimated costs, Mathematical studies, Cooling water, Economic aspects, Costs, Projections, Prediction, Water costs, Planning, Water use, User charges, Water use efficiency, *Chemical industry, *Pulp and paper industry, Evaluation, Estimating equations, *Arkansas.

Water demand functions were estimated for the paper and chemical industries in Arkansas using data collected from individual industrial plants throughout the state. Water demand functions were estimated using regression analysis on data derived from information on: water intake and gross use by source; recirculated water use; costs of acquiring, treating, and discharging water; plant output; plant employment; and plant level of technology. The demand for water intake was primarily estimated as an exponential function of the average water costs and the level of technology. Cost elasticities of demand were estimated as being approximately equal to one for both industry types (-0.94 for chemical plants; -1.06 for paper plants). It was determined that the results could be used to assess the effects of various public policies (e.g., water quality standards) on water withdrawal for industrial purposes. From historical analysis and water demand function estimates, it appeared that industrial water use has followed national trends, particulqrly for the heaviest industrial water user, the paper industry. However, the data indicated that the two Arkansas industries examined are somewhat more responsive to water cost changes than is true nationally. (Zielinski-MAXIMA)
W82-06160

AN INVESTIGATION OF SOME FACTORS INFLUENCING THE PERFORMANCE OF A RECREATIONAL TROUT FISHERY,
Severn-Trent Water Authority, Birmingham (England), Scientific Services.
K. A. Bryan.
Journal of Applied Ecology, Vol 19, No 1, p 113-131, April, 1982. * Fig, 5 Tab, 29 Ref.

Descriptors: *Fish populations, *Recreation facilities, Fishing, Water quality, Tittesworth Reservoirs, Lakes, Drawdown, Drought, Water demand.

Following complaints from fishermen that the fish in the Titteworth Reservoir 'put and take' trout fishery were emaciated and difficult to catch, an investigation was conducted comparing these fish with fish from other sources, as well as monitoring water quality and phytoplankton samples. The trout were shown to have suffered a temporary setback in 1976, which was primarily atrributable to the drought of 1975/76. Phytoplankton numbers, which prior to 1976 were considered large enough to warrant annual treatment with copper slufate, dropped significantly and had not recovered by 1979. Chemical analyses had not revealed any change in water quality. Nitrate and silicate concentrations showed no trends during 1969-79, although phosphate levels decreased very slightly. The severe drawdown and reduced retention time of the reservoir in 1975-76 was perhaps the reason for the diminished phytoplankton, although it is more commonly thought that the greatly increased zooplankton population contributed to the algal loss through grazing. Analysis of the gut contents of trout in 1977 and 1978 revealed that large amounts of plant material and indigestible items had been eaten. Fish stomachs in both years were frequently empty. It was concluded that the repeated drawdown of the reservoir for water supply, including the effects of the 1975-76 drought, may have reduced the numbers and species diversity of food organisms available. (Baker-FRC)
W82-06329

POLICING DEMAND THROUGH PRICING,
Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, Jr.
Journal of the American Water Works Association, Vol 74, No 6, p 288-291, June, 1982.

Descriptors: *Water demand, *Pricing, Conservation, Economic aspects, Water conservation, Water rates, Fairfax County Water Authority, *Virginia.

The Fairfax County Water Authority provides water service to a large segment of the northern Virginia population, comprising all or part of three municipal jurisdictions. The authority acts as the county's billing agent for sewer service charges based on water consumption. The area has an annual average rainfall of 12 meters. The case for water use management or conservation stems not from a scarcity of water but rather from the unwillingness of the citizenry to construct unwarranted water and sewer facilities. The water use management goal for this area is aimed at utilizing the water economically and assessing the cost for various activities equitably. The objective is to avoid wasting water regardless of the water use activity the customer selects, without passing judgment on the merits of the activity. The four most sifnificant activities for fostering a more acceptable customer attitude for direct water conservation include alerting customers to unusually high consumption prior to billing and investigating the cause, issuing pressure-reducing valves without cost to customers whose plumbing predates the existing Code, submitting suggestions for plumbing code revisions relative to water conservation to the jurisdictions served by the authority, and utilizing a peak use charge as part of a rate schedule to lower the maximum or peak demands The peak use charge applied in this county is acceptable to customers because it economically encourages water conservation during peak seasons, it is a fair and equitable rate, it is not punitive, it has an economic basis, it affects only the one fourth of the customers who create the demand, and customers who minimize winter consumption and who do not exceed their peak period allowance can maintain an economical annual water and sewer cost. (Baker-FRC)
W82-06352

DISTRIBUTING THE RISKS OF INTERBASIN WATER TRANSFERS UNDER DROUGHT CONDITIONS: THE DILEMMA POSED BY COAL SLURRY PIPELINES.
Teknekron, Inc., Berkeley, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256595, Price codes: A10 in paper copy, A01 in microfiche. Report, March, 1982. 201 p, 13 Fig, 41 Tab, 98 Ref, 4 Append. OWRT C-90202-G (0419) (1) 14-34-0001-0419.

Descriptors: *Interbasin transfers, *Pipelines, *Coal, *Drought, *Water supply, Water transfer, Conveyance structures, Pipes, Slurries, Coal mining, Water deficit, Water shortage, Water demand, Water conveyance, Water requirements, Interstate compacts, Water use, Alternative water use.

Problems are examined concerning the use of western water to transport coal in slurry pipelines from mines to generating facilities during western water shortages. Potential water shortage risks to the parties-at-interest were identified and reviewed. It was found that, while each of three pipelines considered originates in an arid western state (Wyoming, Colorado, Utah), the water availability level, water use for irrigation, and the likelihood of local water shortages in the surrounding community varies considerably in each locale. The risks associated with western water use for pipelines fall heaviest on agricultural users who might need such water during water shortage periods. It is concluded that, to mitigate this problem, pipeline companies must analyze their selection of a water source for pipelines more carefully; as a condition of directing this water, they should participate in further water resource development and conservation projects beneficial to the surrounding community, and they should seek to alter adverse public perceptions associated with coal slurry pipelines in the western states. Further, additional study must be made on the hydrologic characteristics of water sources that may be used for pipeline diversions, and on the precedential effect of using Missouri River water for the ETSI pipeline (running from Wyoming's Powder River Basin to Oklahoma, Arkansas, and Louisiana). (Zielinski-MAXIMA)
W82-06365

MUNICIPAL AND INDUSTRIAL WATER DEMANDS OF WESTERN U.S.,
Southern Univ., Baton Rouge, LA. Dept. of Civil Engineering.
E. S. Joseph.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil engineers, Vol 108, No WR2, p 204-216, June, 1982. 4 Fig, 11 Tab, 18 Ref.

Descriptors: *Water requirement, *Industrial water use, *Municipal water, Water demand, Water consumption, Water conservation, Water use, Western states, Prediction, Energy, Mining, Arid lands.

Water requirements for the western U.S. are separated into residential, municipal and industrial uses. In 1980 the average per capita residential use in 17 western states was 125 gal per day; average municipal and industrial use, 195 gal per day. The ratio of maximum to average total water use was 1.88. Factors affecting water requirements are population, degree and type of industrial development, level of economic development, climate, metering and pricing, water pressure and leaks, and degree of residential conservation. The ratios of projected water requirements to 1980 requirements for the west as a whole are 1.05 for 1985 and 1.20 for 2000. Similar ratios for industrial water use are 1.08 for 1985 and 1.13 for 2000. Ratios for combined municipal and industrial use are 1.07 for 1985 and 1.16 for 2000. Manufacturing uses 38% of industrial water in the west at present; energy, 43%; and mining, 19%. By the year 2000 mining's share is expected to increase 22% and manufacturing to decrease to 30%. No significant changes are anticipated in per capita municipal water use. Although the industrial sector is expected to save water by conservation, the ratio of consumption (the part of withdrawal which is evaporated) to industrial withdrawal is expected to nearly double (0.26 to 0.49) from 1980 to 2000. The tables in this paper are further subdivided, giving separate listings of the above projections for nine western areas, for residential and commercial-public municipal use, for three types of industries (manufacturing, energy, and mining), and for eight categories of manufacturing. (Cassar-FRC)
W82-06463

RUTLAND WATER NATURE RESERVE: CONCEPT, DESIGN AND MANAGEMENT,
Leicestershire and Rutland Trust for Nature Conservation (England).
T. P. Appleton.
Hydrobiologia, Vol 88, No 1-2, p 211-224, March, 1982. 5 Tab, 2 Fig, 8 Ref.

Descriptors: *Wilderness areas, *Wildlife, *Wildlife habitats, *Conservation, Reservoirs, England, Water supply, Land use, Zoning, Land resources, Project planning, Design criteria, Recreation, Water sports, Forest watersheds, Rutland water, Multipurpose reservoirs.

Practical conservation management has helped to create a nature reserve of international importance for wildfowl at Rutland Water. The reserve is composed of three sections - one with public access, one undisturbed, and one with restricted access for naturalists. Disturbance to the wildfowl was further minimized by separating conflicting recreational activities from animal habitats, by es-

tablishing a 50 meter sanctuary zone around the reservoir, and by constructing special wildfowl lagoons. Reservoir operation must be carefully planned to foster wildfowl populations. (Titus-FRC)
W82-06471

ESCAPING FROM PRISON: AN ECONOMIC REASSESSMENT OF RUTLAND WATER,
Leicester Univ. (England). Dept. of Economics.
P. R. Herrington.
Hydrobiologia, Vol 88, No 1-2, p 27-42, March, 1982. 5 Tab, 30 Ref.

Descriptors: *Economic aspects, *Evaluation, *Water demand, *Public policy, *Reservoirs, Cost analysis, Water rates, Economic evaluation, Economic prediction, Water supply, Water supply systems, Forecasting, Projections, Growth rates, Rutland Water, *England.

Recently in the water industry interest has been growing regarding solutions to the widening supply-demand gaps. In this vein, the 1970 decision to build Rutland Water is reassessed. The reassessment reveals that the expected population growth had been overestimated and the water demand forecasts were inaccurate. In the projections no distinction was made between unmetered and metered consumption. Although very little data was available at the time the construction decision was made, the expectation of rapid population growth at the time was sufficient to lead to the decision to build the reservoir. By 1981 a dramatic reduction in expected population and per capita water supply growth had occurred; had the choice of building a reservoir been faced in 1981, the decision would probably have been not to build. (Titus-FRC)
W82-06479

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,
North Yorkshire County Council (England).
For primary bibliographic entry see Field 6B.
W82-06480

RUTLAND WATER - FROM CONCEPTION TO OPERATION,
Anglian Water Authority, Leicestershire (England).
E. A. Knights.
Hydrobiologia, Vol 88, No 1-2, p 7-17, March, 1982. 1 Tab, 4 Fig.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, *Public opinion, England, *Project planning, Evaluation, Water supply, Water demand, Public policy, Water policy, Construction, Rutland Water, Multipurpose reservoirs.

Rutland Water was planned in the 1960s to meet the water needs of the East Midlands region of England. Chosen from 64 possible sites, it was approved in 1970, subject to the following restrictions: (1) the economic burden should not fall entirely on the local ratepayers; (2) perimeter lands should be returned to agricultural use; (3) new roads and services should replace those lost to flooded areas; (4) adequate compensation flow was required in the river below the dam, and (5) the character of the landscape and the rivers involved should be retained. Construction began in 1971 and filling of the reservoir began in 1975; pumping from the rivers began in 1976; the reservoir was completely filled by 1979. It requires relatively little maintenance, although siltation has produced colonies of submerged plants in some areas and erosion has occurred at the margins of the reservoir. Recreational uses of the reservoir--especially fishing and sailing--are integrated with its water supply function. (Titus-FRC)
W82-06481

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,
Policy Sciences Associates, Boulder, CO.
For primary bibliographic entry see Field 3D.
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 3D.
W82-06705

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,
Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
E. W. Clyde.
Natural Resources Lawyer, Vol 14, No 3, p 519-540, 1982. 48 footnotes.

Descriptors: *Water rights, *Energy, *Water allocation, Water storage, Water conservation, Water transfer, Water supply, Water law, Legal aspects, Water management, Appropriation, Permits, Industrial water, Irrigation water, Excess water, Institutional constraints, Interbasin transfers, Contracts, Public rights, State jurisdiction.

The large quantities of water required for energy development in the western U.S. may be obtained by several means. This paper reviews the historical development of water rights and the changing allocation system. Statutes are beginning to recognize public interest as a significant factor in assigning water rights. 'New' water available during high water in random years may be stored under a permit system. Good management of surplus flows can also produce 'new' water, for example, using excess surface water during wet years instead of pumping groundwater. Water shortages can be created by legal constraints: prohibition of interbasin and interstate transfers, legislative control of large appropriations, and legal uncertainties such as Indian water rights and the ownership of wastewater effluents. There are several ways for energy companies to assemble water rights for a large project--purchase of early priorities, storage in underground basins or reservoirs, contracting to buy water when needed, replacing lost crops during dry years in exchange for primary water rights, building storage or improving irrigation efficiencies for local farmers, and direct purchase of water with no conditions attached. (Cassar-FRC)
W82-06839

6E. Water Law and Institutions

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,
Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 119-138, January, 1982. 1 Fig, 12 Ref.

Descriptors: Legal aspects, Water resources development, *Groundwater management, Water supply, Water demand, Regulations, Management.

The search for and extraction of groundwater supplies has been of interest only in recent times. Man is waking up the disastrous consequences of unrestrained groundwater use and abuse. The essentials of traditional groundwater law are reviewed. The widespread agreement among specialists that underground water law and administration should now be treated as part of all freshwater resources law and administration has more meaning than simply the placement of the ground water rules in the same law or regulatory document where surface water norms are found. It means that the same basic development, use and conservation policies should be applied to the resource as a whole. Identical treatment in the law and regulations is not intended. Integrated management is sought in order to achieve the optimum sustained yield of a nation's total water resources. Peculiar physical incidents in the appearance, movement and availability of groundwater that require special regulations and a particular administration are noted. Even so, the makers of development and environmental protection policy need to have at their disposal the entire picture of the quality and quantity of the water resources within their jurisdiction, including underground water resources, and to be able to work toward optimum use of the whole, without major sacrifice of other values enshrined in the community they serve. (Baker-FRC)
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
A. E. Utton.
Natural Resources Journal, Vol 22, No 1, p 95-118, January, 1982. 88 Ref.

Descriptors: *Legal aspects, *Groundwater management, Legislation, Regulations, Water demand, Water resources development, *International law, International agreements.

Increasing demands on water supply and a lack of adequate laws and legal institutions for the management of groundwater or the resolution of disputes will lead to problems in the future. Increased population means increased competition for water. While the United Nations reports that there is no actual physical global shortage of water, there is an uneven distribution of the resource. It is imperative that available supplies be managed prudently and utilized efficiently. The laws governing groundwater nationally are inadequately developed. Developments in national groundwater law are reviewed, along with developments in transboundary groundwater law. Recommendations are offered for the management of transboundary groundwaters. Some management alternatives are offered, including equitable apportionment, case-by-case negotiation, comprehensive management, the allocation process, and studies of water quality. (Baker-FRC)
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,
Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 71-93, January, 1982. 62 Ref.

Descriptors: *Legal aspects, *Aquifers, Groundwater, Water resources development, Regulations, *International law, International agreements.

An accounting was made of the efforts exerted to date at the international level, both intergovernmental and nongovernmental, toward consideration of transnational groundwater in conjunction with surface water and within intergovernmental institutions tailored to the purpose. In the future conjunctive use and integrated protection of groundwater and surface water may become a reality, from the planning stage to the delivery of water services. Perceptions at the international level are described as of 1966, when the Helsinki Rules were adopted. International developments since 1966 are noted. Events are noted in the field of groundwater law and administration at the national level. In most countries the legal regimes governing groundwater are still substantially separated from the legislation or case law governing surface waters. Groundwater rights are usually appurtenances to the land, but even where restrictions, including permit systems, have been imposed, the owner of the overlying land still enjoys a preferred position. The trend is clearly in the direction of severing water rights from the property law concept of ownership in the classical, strict sense. Surface waters nearly everywhere today are subject to significant use regulation. The growing willingness of communities to exercise some control over groundwater can be seen in the widespread, quantitative limitations on pumping. (Baker-FRC)
W82-05940

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,
J. Pruett.
Natural Resources Journal, Vol 22, No 1, p 243-245, January, 1982. 12 Ref.

Descriptors: *Water pollution control, *Legal aspects, Wastewater discharge, Legislation, Jurisdic-

tion, Legal review, *Shenango River, *Pennsylvania.

A citizens' suit was filed in federal district court pursuant to the Federal Water Pollution Control Act. The complaint in this suit alleged that members of the Board of the North and South Shenango Joint Municipal Authority and various conctractors and construction corporations were releasing untreated sewage into the Shenango River and its tributaries. Eventually the court found that the Authority had violated state discharge limits and ordered the Authority to prepare a timetable containing plans to reduce its discharge to legal limits. There was lengthy discussion that proper notice had not been given, and the defendants argued for dismissal on those grounds. However, the courts followed a broad interpretation of the absolute notice requirement. In the exercise of the court's discretion, however, it had closely followed the legislative intent behind the notice requirement. All defendants had time to investigate the alleged violations and correct them, or to prepare a defense. This approach should be followed in other courts, as it both satisfies legislative intent and also conserves judicial resources. (Baker-FRC)
W82-05986

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,
Nairobi Univ. (Kenya). Inst. for Development Studies.
C. O. Okidi.
Natural Resources Journal, Vol 22, No 1, p 161-199, January, 1982. 192 Ref.

Descriptors: *Water resources development, *Treaties, Legal aspects, Legislation, International agreements, *Nile River, *Lake Victoria, Drainage basins, Consumptive use, Africa, Water use, Planning.

All of the states sharing the Nile and Victoria basins have achieved political independence since 1960, yet there have been no agreements concluded since that time on the uses of the Nile. Since 1960 the range of uses to which the water is put presumably has increased, and there may be many plans under consideration for still wider water usage, so that the safeguards in the pre-1960 treaties will prove inadequate. This paper analyzes the range of instruments that has been signed in an attempt to create cooperation in the consumptive uses of the waters of the Nile Basin, the adequacy of existing treaties to cope with the full range of possible and actual uses of those waters, and some recent developments in terms of actual or planned projects in the basin states, which indicate an urgent need for an up to date framework for dealing with Nile and Lake Victoria waters. Geographical and technical perspectives are considered. Agreements on the Nile and Lake Victoria waters are reviewed, including pre- and post World War I agreements, the Owen Falls Dam agreements, the 1959 agreement for full utilization of the Nile waters, the protocol concerning the permanent joint technical commission, the agreement for the hydrometeorological survey of Lakes Victoria, Kyoga, and Albert, and the agreement for the establishment of the organization for management and development of the Kagera River basin. Post-1959 agreements for Egypt, Sudan, Ethiopia, Tanzania, and Kenya are presented. What seems abundantly clear throughout these agreements is the desirability of a framework for consultation and exchange of information on actual or intended projects involving utilization of the basin waters. (Baker-FRC)
W82-05987

SMALL SCALE HYDROELECTRIC DEVELOPMENT AND FEDERAL ENVIRONMENTAL LAW: A GUIDE FOR THE PRIVATE DEVELOPER,
Boston Coll., Chestnut, MA.
S. H. Burke.
Boston College Environmental Affairs Law Review, Vol 9, No 4, p 815-861, 1981. 315 Ref.

Descriptors: *Hydroelectric power, *Legal aspects, Electric power generation, *Federal jurisdiction, Regulations, Reviews, Licensing, Planning, Water use, Water resources management, Environmental effects.

This article provides a general guide to the major federal environmental laws affecting the planning and construction of hydroelectric facilities and shows how the federal licensing process has been affected by these laws. Each statute is described in sufficient detail to familiarize the reader with the scope and purpose of the law and to allow him to predict generally its impact on a particular proposal. The article is divided into three broad areas: disclosure and consideration of environmental impacts, which describes the role of federal regulatory agencies in the evaluation of the general and resource-specific environmental impacts of proposed hydroelectric facilities before authorizing their construction; federal resource management, which provides for the protection, conservation, and management of particularly sensitive resources; and compliance with licensing procedures to ensure environmental protection. While the development of the hydroelectric potential of the country's rivers and streams will continue to be strongly influenced by the wealth of federal environmental legislation passed in the last two decades, regulatory agencies may not authorize a project before the environmental effects of the facility have been identified and considered. Special attention must be given to preservation of endangered species, fish and wildlife resources and historic resources. Proponents of hydroelectric development should be familiar with the requirements of federal environmental law and should consult with appropriate federal agencies to identify environmental impacts of such facilities. (Baker-FRC)
W82-06002

DISCUSSION ON AN ECONOMIC ANALYSIS OF WATER CONSERVATION POLICY, BY WILLIAM WHIPPLE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman.
Water Resources Bulletin, Vol 18, No 2, p 345-347, April, 1982. 7 Ref.

Descriptors: *Water policy, *Political aspects, *Water conservation, Legal aspects, Economic analysis, Conservation, Reservoirs, Water resources development, Water storage, Dam construction, Legislation.

A comment on the above paper, originally published in Water Resources Bulletin, Vol. 17, No. 5, p 814-819, extends the discussion of the failure of the Carter administration water policy reform proposals. Although the original proposal included groundwater management, fish and wildlife habitat maintenance, and a broadening of management alternatives, halting of construction projects and water conservation were strongly emphasized. A battle developed between congressional committees (in control of water policy for many years) and the administration over the definition of conservation, whether or not conservation included surface water storage. The debate centered on demand reduction (administration) vs. surface storage (opponents), and the two branches of government never arrived at an effective policy reform. The proposed technical assistnace grants program designed to improve the states' water resources planning capacity was eliminated by the Senate because approval would have meant agreement with the administration's definition of conservation. (Cassar-FRC)
W82-06069

APPLICATION PROCEDURES FOR HYDROPOWER LICENSES, EXEMPTIONS AND PRELIMINARY PERMITS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC-0097, April 1982. 192 p, 2 Tab, 2 Append.

Descriptors: *Hydroelectric plants, *Licensing, *Legal aspects, *Permits, Regulations, Construction, Dams, Electric powerplants, Feasibility studies.

The Federal Energy Regulatory Commission assumed most of the responsibilities for regulating non-Federal hydroelectric power projects. The commission issues preliminary permits and licenses, and grants exemptions from licensing for the pprupose of authorizing construction and operation of non-Federal hydroelectric projects. The Commission has revised its regulations to simplify and expedite the hydropower licensing process. The amount of information required for each type of application is directly related to the complexity of the proposed action. The Commission's revised regulations and the basic requirements for filing each type of application are presented. The Commission's regulations provide a range of alternatives for development of a hydropower project. A prospective developer may elect to apply for a preliminary permit, which allows a specific term for the developer to determine the feasibility of developing a hydropower project at a specific site, and to perform studies to support a license application. The Commission's regulations for licensing group proposed projects according to the level of anticipated complexity and potential impact into three categories: major unconstructed projects and major modified projects greater than 5 MW; major projects greater than 5 MW at existing dams; and minor projects and major projects 5 MW or less. The exemption procedure was instituted for small hydroelectirc projects which meet certain characteristics and have an installed capacity of 5 MW or less. (Moore-SRC)
W82-06088

UNITED STATES V. WARD: FWPCA CIVIL PENALTY PROSECUTION, NOT A CRIMINAL CASE FOR THE FIFTH AMENDMENT,
M. G. Grace.
Columbia Journal of Environmental Law, Vol 8, No 1, p 115-135, 1981. 129 Ref.

Descriptors: *Water law, *Environmental protection, *Civil law, *Federal jurisdiction, *Judicial decisions, Legal aspects, Case studies, *Water quality standards, Civil defense, Water pollution control, Jurisdiction.

The Federal Water Pollution Control Act (FWPCA) is designed to restore and maintain the chemical, physical, and biological integrity of the Nation's water. Under section 1321 of the act, failure to report oil spills or spills involving other contaminants is a criminal offense punishable by a fine of up to $10 thousand and/or imprisonment. In the Supreme Court case of the United States v. Ward, the court had the opportunity to define the constitutional limits on compulsory self-reporting in a leading environmental protection statute carrying a penalty labeled as civil. An in-depth study of section 1321 would have established guidelines for future challenges to the congressional labeling of penalty provisions and prevented trends toward administrative streamlining which endangers the right against self-incrimination. Instead, the Supreme Court ignored the guidance laid down in an earlier case and subordinated the rights of individual defendants by upholding the civil penalty feature of the act and denying offenders the rights accorded to criminal offenders. (Geiger-FRC)
W82-06181

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,
San Francisco Bay Inst., CA.
W. T. Davoren.
Coastal Zone Management Journal, Vol 9, No 2, p 111-153, 1982. 2 Fig, 61 Ref.

Descriptors: *Bays, *Water resources development, Water supply development, San Francisco Bay, California, California Coastal Act, Legal aspects, Legislation, Planning.

In 1968 the attention given to the problems of San Francisco Bay was reaching its peak. The California Coastal Commission was established in 1966, and in 1981 it was again before the Legislature for fine tuning. However, the San Francisco Bay area was not included in the more rigorous requirements which were applied to the coast from 1973

to 1976, nor in the 1976 Coastal Act. At present the Bay Conservation and Development Commission is directed to rely on the Federal Coastal Zone Management Act's consistency features to overview the Corps of Engineers' actions on permits in many areas. Much of the history of California revolves around water and its development for man's use. Much of the history of California revolves around water and its development for man's use. Two giant public water development projects, one federal and one state, have dominated California water issues since the 1930s. These were the Central Valley Project of the Bureau of Reclamation and the State Water Project. Both the state and federal projects are readying for a new round of expansion. State water politics are currently dividing along lines that define its seven or more water regions. Several studies have been made of the bay's progress and prosperity, including the Reber Plan, the SERL Studies, Kaiser Engineers Report, and others. During the period of deep environmental concern of the 1970s, little was accomplished as far as the San Francisco Bay's predicament is concerned. Two federal projects, the super dam and the drain, will have great influence in the future on the Bay area. A brief summary of what the Bay's own agencies have been doing is presented. (Baker-FRC)
W82-06182

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,
O'Melveny and Myers, Los Angeles, CA.
O. Olpin, and B. H. Thompson.
Natural Resources Lawyer, Vol 14, No 4, p 635-654, 1982. 44 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, Federal jurisdiction, Public rights.

Two distinct types of legal problems may emerge in geothermal developments: the need to seed water from outside the geothermal system for cooling and other uses, and the need to produce geothermal fluids as the transfer medium for the heat energy. Various approaches to the second type of problem are reviewed, problems associated with the fluids, in liquid or gaseous form, produced by geothermal wells. A brief survey of western water law is presented, concerning both surface and groundwater. Problems for hydrothermal systems using groundwater arise through the need to abide by state water laws which may have been designed for other contexts and thus call for inappropriate procedures. Even more significant problems arise from various state rules and regulations designed to protect prior appropriators' groundwater sources. The geothermal developer may find that the desired development is in a designated critical basin or is connected to an aquifer that is being depleted. Under these conditions it will be difficult to obtain an appropriation permit, at least for the amount of fluids that he foresees his development will need. In many states it is also necessary that the proposed appropriation be in the public interest, which may mean that the developer will have to convince another layer of the state government that the development is in the public interest as that agency sees the situation. The doctrine of 'developed water' may be helpful in some states, as one who develops water which would not otherwise have been generally available is entitled to appropriate the water without regard to normal state water rules. The use of Federal reserved water rights may also be helpful. Several recommendations are offered to ease the situation for geothermal entrepreneurs. (Baker-FRC)
W82-06218

IMPLICATIONS FOR THE WATER INDUSTRY OF THE NOTIFICATION SCHEME FOR NEW CHEMICALS,
Department of the Environment, London (England).
N. J. King.
Water Pollution Control, Vol 81, No 2, p 245-254, 1982. 5 Ref.

Descriptors: *Data collections, *Chemical compounds, Chemical properties, Toxicity, Solubility, Permeability, Chemical reactions, Environmental effects, International commissions, International agreements, Legal aspects.

The notification scheme for new chemicals requires that all new chemicals with a sale of greater than 1 tonne per year must be reported to the national competent authority, including information in the notification regarding use, production level, properties, and special handling, storage, labeling and disposal requirements; that the competent authority may require additional information at any time but must consider the need for such information as various levels of production and sales are reached; that certain categories of substances are exempted and others are already subject to similar directives under other laws; as well as additional requirements. While the directive requires the Commission of the European Communities and the member states to keep confidential information secret, the final decision on what is confidential rests with the compent authority. At its simplest, the scheme is a means of monitoring industry's compliance with the general duties to take steps to ensure the safety of its products and to protect the environment. As the information accumulates, it would in time serve as an invaluable source of data should an emergency occur. Others in the water industry, for example, may need information on toxicity, degradability, or other properties of chemicals and would now be able to secure such information. Such an accumulation of substance-related information is also likely to be a valuable tool in developing knowledge of structure-activity relationships, particularly if it can be linked to data collected in the field. In this respect the water industry may be able to contribute field experience, (Baker-FRC)
W82-06261

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5E.
W82-06291

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,
By K. McCray.
Water Well Journal, Vol 36, No 6, p 42-43, June, 1982.

Descriptors: *Groundwater management, *Legislation, Water pollution control, Water resources development, Mining wastes, Hazardous wastes, Legal aspects, Water conservation, Drinking water.

The use of the nation's groundwater resources has been significantly affected by five items of federal legislation. The Clean Water Act was in reality a series of 1972 amendments to the Federal Water Pollution Control Act of 1948 whose main objective was to protect surface water. With its emphasis on surface waters, the Act has been thought to have increased groundwater pollution by diverting pollutants from surface waters to the ground. The Safe Drinking Water Act of 1974 was created to protect the drinking water supplies by providing for the establishment of primary and secondary standards for levels of contaminants in water supplies, the creation of an underground injection control program, and the protection of soil-source aquifers. The Resource Conservation and Recovery Act of 1976 is the federal government program for managing solid wastes and hazardous wastes that may significantly contribute to serious illness or that may impose a hazard to human health or the environment when improperly managed. The Surface Mining Control and Reclamation Act of 1977 is intended to prevent imminent danger to the health and safety of the pubic or harm to land, air or water resources resulting from both surface and underground mining operations. The Comprehensive Emergency Response, Compensation and Liability Act of 1980 expands the federal government's response authority to hazardous waste dangers to include pollutants or contaminants which may present an imminent and substantial danger to the public health or welfare. (Baker-FRC)
W82-06295

GROUND WATER LAW IN PUERTO RICO.
Water Well Journal, Vol 36, No 6, p 64-66, June, 1982.

Descriptors: *Groundwater management, *Legislation, *Puerto Rico, *Groundwater protection, Groundwater pollution, Water resources development, Water pollution control.

In 1981 the Rio Piedras Agricultural Station published a first inventory of wells to have been conducted in Puerto Rico. The inventory provides hydrometric information on spring and well water for wells within the jurisdiction of the agricultural station. The residents of rural areas may be the largest users of well water. Puerto Rico has laws for protecting the purity of groundwater. In 1948 the groundwater was felt to be of a quality generally safe to drink, whereas most of the surface waters were polluted and unsafe to drink without prior treatment. Until a few years ago Puerto Rican groundwater had no legal institutional framework to guide its management. No state agency was authorized to control water extraction wells. There was no clear definition of functions and responsibilities related to groundwater. In 1972 the Natural Resources Law created the Department of Natural Resources and transferred most powers and responsibilities to it, including the granting of permits for water use and for drilling of water wells. In 1976 the Law for the Conservation, Development and Utilization of Water Resources in Puerto Rico made waters and water bodies public wealth, and the government was entrusted with managing and protecting this national wealth. The Department of Natural Resources is the agency responsible for monitoring the extraction rate of groundwater, the recharge rate of the aquifers, the reduction of the phreatic level and possible contamination of the aquifers. The Environmental Quality Board is responsible for the preparation and publication of groundwater regulations and standards. The Department of Health protects the purity of the water supplies through monitoring. The Aqueduct and Sewer Authority plans, designs and builds drinking water treatment plants and facilities to serve residential, industrial and commercial areas. The United States Geological survey operates observation wells to detect saline intrusion problems and has performed the majority of the groundwater studies in Puerto Rico. (Baker-FRC)
W82-06296

GROUND WATER AND THE STATES,
By K. McCray.
Water Well Journal, Vol 36, No 6, p 47-50, June, 1982.

Descriptors: *Groundwater management, *Legislation, Legal aspects, Groundwater pollution, Aquifers, *State jurisdiction, Water pollution control, Regulations.

A sampling of legislation that has been or is being considered for the use and protection of groundwater is offered. Other regulatory actions that have taken place in some states are also cited. In Arizona a ruling was made which upheld the constitutionality of the 1980 Ground Water Management Act. In Colorado consideration is being given to a bill that would require persons owning water rights to register such ownership and a current address with the state engineer. In Iowa the Natural Resources Council has called for requirements that specify the need for embankments around quarries to block runoff and for test wells around a quarry to monitor the quality of nearby groundwater. In Kansas the Governor has recognized the state's efforts to control water supplies with a new statewide plan for management of groundwater quality. In Louisiana the water laws are under study regarding ownership, water rights, regulation of chemical waste injection wells, protection of drinking water, and other aspects of water control. In Massachusetts reaction was favorable to increased federal protection of Cape Cod drinking water sources. In Michigan after three years of rejection the Joint Administrative Rules Committee adopted the latest draft from the Department of Natural Resources for compliance with the Solid Waste Management Act, signed into law in 1978.

Mississippi is considering new injection well regulations. Montana has a proposed regulation aimed at preventing aquifer pollution from mining, industrial, municipal and private sources. Nebraska is tightening state policies on reusing irrigation water. New York is studying groundwater use and distribution. Oregon exempted pump installers from registering under various conditions. Laws being considered in Pennsylvania, Rhode Island, South Carolina, Virginia, West Virginia, and Wisconsin are also briefly noted. (Baker-FRC)
W82-06297

GROUNDWATER POLICY: A PATCHWORK OF PROTECTION,
Environmental Law Inst., Washington, DC.
A. Horne.
Environment, Vol 24, No 3, p 6-11, 35, April, 1982. 1 Fig, 71 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Legal aspects, *Water pollution control, *Legislation, *Water policy, Water resources development, Groundwater, Regulations, Water management, Local governments, Environmental control, Environmental protection.

The existing legal framework for groundwater protection has come under attack in recent years. This article focuses on the legal framework for groundwater protection rather than on the problem itself. Each of the federal statutes pertaining to groundwater protection (Federal Water Pollution Control Act Amendments of 1972, Safe Drinking Water Act of 1974, Toxic Substances Control Act, Resource Conservation and Recovery Act of 1976, and Surface Mining Control and Reclamation Act of 1977) is briefly described and a summary of state laws is provided. EPA proposed policies for groundwater management assume that federal, state, and local governments already possess sufficient authority and resources to protect existing supplies. Response to these policies have been mixed, with industries declaring the regulations too stringent and environmentalists claiming they are too weak. In 1981, task groups were formed to review groundwater problems. Unresolved issues consist of deciding on the level of water quality desired, relegating authority among federal, state, and local governments, finding proper strategies for the monitoring of groundwater supplies, translating a desired level of protection into specific regulatory tools, and finding methods of land use controls to protect recharge zones. (Geiger-FRC)
W82-06411

OCEAN DUMPING BATTLE MARCHES ON,
For primary bibliographic entry see Field 5E.
W82-06490

LANDSPREADING OF SLUDGE IN NEW YORK STATE,
For primary bibliographic entry see Field 5E.
W82-06557

MINERAL LAW SINCE NEPA,
Bureau of Land Management, Boise, ID. Idaho State Office.
T. S. Maley.
Idaho Law Review, Vol 18, No 1, p 73-95, 1982. 149 Ref.

Descriptors: *Legislation, *Minerals, Legal aspects, Environmental effects, Watershed protection, Water pollution prevention, Mining, Industrial wastes.

The primary purpose of this article is to identify and describe most of the major legislative and regulatory programs established since the National Environmental Policy Act of 1969 was put into effect that will significantly affect the future of exploration, mining and ore processing operations. In addition to the multitude of environmental laws designed to protect air and water quality, solid waste management, endangered species and cultural resources during this period, there have been several major new leasing programs covering geothermal resources, coal, outer continental shelf oil and gas, and deep seabed hard minerals. Specifically, discussion is offered on public land withdrawals including roadless area review and evaluation programs; environmental laws including the coastal Zone Management Act of 1972, the Resource Conservation and Recovery Act of 1976, water quality reviews, the Uranium Mill Tailings Radiation Control Act of 1978, air quality reviews, endangered species act, cultural resources, and state environmental law and zoning; mine land reclamation and mine safety and the mangement of minerals aquired by lease or permit. The geothermal steam act is discussed as it permits leasing of geothermal resources in federal lands. (Baker-FRC).
W82-06582

ORGANIZATIONAL AND POLITICAL CONSIDERATIONS IN THE MUNICIPAL DEVELOPMENT OF SMALL HYDROPOWER,
Maine Office of Energy Resources, Augusta.
P. A. Heidell, and P. H. Kirshen.
Water Resources Bulletin, Vol 18, No 1, p 105-110, February, 1982, 9 Ref.

Descriptors: *Hydroelectric power, *Local governments, *Political aspects, Dams, Public participation, Political constraints, New England.

There is considerable potential for small-scale hydroelectric power development at existing dams in New England, where over 10,000 dams are currently in existence. Although small-scale hydroelectric powerplants have many economic and environmental advantages, a variety of constraints may hinder development efforts. Efforts by three New England municipalities in unique positions to develop hydropower demonstrate the role of organizational and political considerations in development. Organizational elements and political processes which were integral to the success of these development efforts included cooperation and interaction among citizens, government, and the private sector; community interest and education; and strong resolve. Government support and a social, political, and institutional atmosphere conducive to public development of energy resources were also necessary. Information dissemination and citizen education efforts were found to be crucial factors, especially in municipalities requiring majority approval for municipalization, acquisition of facilities, and grant and loan applications. State and Federal governments can, and do, both assist and hinder a municipality's efforts to develop hydroelectric power. (Carroll-FRC)
W82-06588

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,
For primary bibliographic entry see Field 5E.
W82-06598

WHO OWNS NEBRASKA'S GROUND WATER,
Nebraska Univ. Lincoln.
J. Fussell.
Water Well Journal, Vol 36, No 6, p 44-46, June, 1982.

Descriptors: *Groundwater *Legal aspects,*Ownership, *Nebraska, Supreme Court, Public policy, Policy making, Water policy, Public lands, Public rights, Irrigation, State jurisdiction.

The question of ownership of groundwater in Nebraska becomes more important each year as greater demands are placed on the dwindling supply. Much of the state is underlain by the Ogallala aquifer, one of the largest natural underground reservoirs of water in the nation. Interpreters of Nebraska law indicate that this question falls between the so-called English Rule and the modified American Rule. Under the former rule, the rights to the groundwater belong to the owner of the overlying land. The latter rule holds that the owner of the land is entitled to appropriate subterranean waters found under his land, with the provision that he cannot appropriate such water in excess of a reasonable and beneficial use upon the land he owns, especially if such use is injurious to others who have substantial rights to the water. If the natural underground supply is insufficient for all owners, each is entitled to a reasonable proportion of the whole. On May 1, 1981 the Nebraska Supreme Court filed an opinionin the Douglas vs Sporhase case. Their decision was hailed as unanimous support for the view that groundwater is a public resource. The impact of this decision wil be felt beyond the borders of Nebraska. Not only may its conclusions be cited as legal precedent, but also its reasoning and even the directness of its language incorporated in the court's opinion may be borrowed by persons in various other states. One effect will be to buttress conservation measures in Nebraska and to further sensitize irrigators to the interests of the public. This case has been referred to the US Supreme Court and is being heard under the heading of Sporhase and Moss vs. State of Nebraska, a decision is expected in the summer of 1982. (Baker-FRC)
W82-06819

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,
Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
For primary bibliographic entry see Field 6D.
W82-06839

6F. Nonstructural Alternatives

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,
California Univ., Los Angeles.
For primary bibliographic entry see Field 3D.
W82-05922

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
K. W. Muckleston, M. F. Turner, and R. T. Brainerd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243536, Price codes: A05 in paper copy, A01 in microfiche. Report WRRI-73, December, 1981. 77 p, 10 Fig, 5 Tab, 33 Ref. OWRT A-054-ORE(1).

Descriptors: *Flood plain management, *Land appraisals, *Regulations, *Environmental effects, *Property value, Flood plain zoning, Flood plains, Flow channels, Land management, Legal aspects, Political contraints, Economic aspects, Political aspects, Social aspects, Real property, *Oregon.

A study was made of floodplain regulation impacts on western Oregon residential land values, hypothesizing that the mean rates of appreciation for regulated lands would be significantly less than for similar proximate unregulated lots. Six study areas were used to test this hypothesis, with the finding that the hypothesis could be rejected in most cases. Where the hypothesis was acceptable, flood damage (rather than floodplain regulations) appeared to be the cause. The hypothesis converse was not uncommon: the mean appreciation rates for regulated land increased significantly faster than for unregulated control parcels. It was concluded that this probably reflects the amenity values of waterfront properties and the recent marked improved water quality of the Willamette River. Hence, most of the evidence of this 6-site study suggests that floodplain regulations have not had a significant negative impact on residential land values. Limitations to this study, carried out under less than ideal conditions, which restrict the attainment of final conclusions are discussed. Nonetheless, the study data illustrate that floodplain regulations do not appear to play an important role in the assessment process. (Zielinski-MAXIMA)
W82-05930

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,
Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
For primary bibliographic entry see Field 2E.
W82-05997

MANAGING FLOOD RISK: TECHNICAL UNCERTAINTY IN THE NATIONAL FLOOD INSURANCE PROGRAM,
Bracken and Baram, Boston, MA.
M. S. Baram, and J. R. Miyares.
Columbia Journal of Environmental Law, Vol 7, No 2, p 129-164, 1980. 132 Footnotes.

Descriptors: *Flood plain management, *Insurance, *National Flood Insurance Program, *Risks, *Flood plain zoning, Nonstructural alternatives, Mapping, Surveys, Land use, Decision making, Federal Emergency Management Agency.

The National Flood Insurance Program (NFIP), established in 1968, seeks to control the risk of flood damage by encouraging local government to control land use. Two problems, both attributable to technological uncertainties and changing circumstances, have emerged under the NFIP. First, restudies of a community's flood risk, etc. have used increasing amounts of the total study funds. There are no clear guidelines for determining if a restudy is justified. Second, new technical developments in flood plain mapping and risk prediction are continually being made. It is difficult to determine when new methods should be adopted. Restudies may be necessary because of scientific or technical error, the sudden availability of new data (such as an unprecedented flood), judicial mandate, or community request. This paper proposes that criteria be articulated to guide the Federal Emergency Management Agency (FEMA) in deciding when restudies should be undertaken or new study methods adopted. Several objective, generic criteria suggested by an FEMA contractor are presented as a basis for developing a structured system to decide the need for restudy. They include: extension of study areas, revision of base data, and update of prior studies due to improved methods. (Cassar-FRC)
W82-06073

OFFICIAL AND FOLK FLOOD WARNING SYSTEMS: AN ASSESSMENT,
National Center for Atmospheric Research, Boulder, CO.
R. Schware.
Environmental Management, Vol 6, No 3, p 209-216, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Flood protection, *Warning systems, West Bengal, *India, Floods, Warning systems, Developing countries, Regional development.

The inadequacies of the flood warning system became clear recently in West Bengal, India. Some socioeconomic constraints on the communication of flood warning messages are reviewed. Perceptions of, and responses by, villagers in a flood prone region of West Bengal to official and to folk flood warnings are considered. Most of the major flood-producing rivers originate beyond the jurisdictional limits of West Bengal. Thus to a large extent this riparian state is at the mercy of policies of flood control, water utilization and soil erosion of the neighboring states of Bihar and Assam as well as of Nepal, Bangladesh, Bhutan, and Sikkim. Flooding results from reduction in the drainage capacity of rivers due to excessive sedimentation, breaches in the Zamindari embankments, incomplete construction of new embankments, lack of maintenance of excavated drainage channels, and blockage of inland stream flow by sea tides. Individual responses to flood warnings are conditioned by age, educational level, cultural background, and knowledge or experience of previous situations. Both the increasing encroachment of population into low and alluvial lands of the lower Damodar Valley and the piecemeal attempts to control floods in the region since independence have given rise to problems that affect agricultural production, health, and industrial development. Flood warning messages are not always effectively disseminated to flood-affected communities. At least some reappraisal of the existing approach to flood warnings should be considered. (Baker-FRC)
W82-06077

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06128

WORK MANAGEMENT STANDARDS,
Tampa Water Dept., FL.
D. L. Tippin, and G. M. Barron.
Journal of the American Water Works Association, Vol 74, No 6, p 292-295, June, 1982. 1 Fig, 2 Tab.

Descriptors: *Management planning, *Water supply, Water demand, Tampa, *Florida, Planning.

The Tampa, Florida, Water Department designed and implemented a systems approach to management effectiveness in water services based on standards for both service levels and performance in order to incorporate accountability for the relationship between service provided and dollars spent. Standards provide control for the work management system. They control the kinds and amounts of work performed on each activity through the performance standards established. By defining specific resources, standards allow estimation of the resources needed to complete the goals as outlined by the policy makers. By reporting work accomplished, data are accumulated for the next year's budget, adherence to the current budget is monitored, and the utility is able to determine whether resources are being used effectively. Prior to the distribution division's developing performance standards, maintenance employees were about 30-40% effective in their work performance. It is now estimated that they are more than 70% efficient and show continued improvement. Crew size on all major crews has been reduced by careful analysis of the manpower needs for each activity, and cost savings have resulted from the increased production and work method improvements. (Baker-FRC)
W82-06349

FLOOD RISK PERCEPTIONS AND OVERDEVELOPMENT IN THE FLOODPLAIN,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and W. L. Miller.
Water Resources Bulletin, Vol 18, No 1, p 89-94, February, 1982. 2 Tab, 21 Ref.

Descriptors: *Flood plain management, *Floods, *Risks, Social aspects, Land development, Land use, Land appraisals, Insurance, Economic aspects, Flood damage, *Indiana.

There is a long-standing hypothesis that imperfect information about potential flood hazard, an exception of liberal disaster relief, and anticipation of future structural protection have resulted in overdevelopment of the nation's flood plains. Data for a case study area--Logansport, Indiana--were analyzed using multiple regression techniques in an effort to investigate this hypothesis. The effect of the introduction of the National Flood Insurance Program (NFIP) on residential property values was investigated in order to determine whether flood plain residential property values were fully discounted for expected flood damages. The case study analysis showed that residential property values in the flood plain were less than fully discounted for the existing flooding potential prior to the introduction of the NFIP. Such low cost information as lot elevation and distance from the river were found to affect sale price, apparently due to its role in the formation of flooding potential perception. Flood plain management policy alternatives which would provide better information on flooding potential and eliminate the perverse incentives created by the expectation of liberal disaster relief include simple zoning and actuarial insurance. Simple delineation of the 100-year flood plain with zoning restrictions would involve relatively low implementation costs, while the development of actuarially accurate premiums for flood insurance would be relatively costly. In any case, the study results indicate that unless policy changes eliminating the perverse incentives of past policies are adopted, overdevelopment of flood plains will continue. (Carroll-FRC)
W82-06585

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),
Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
D. Kampe.
GWF, das Gas- un Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 30-38, January, 1982. 4 Tab, 22 Ref. English summary.

Descriptors: *Water policy, *Agriculture, *Water management, *Resources management, Public policy, Hydrology, Drinking water, Water quality, Land use, Water resources developement, *West Germany.

The conflict between drinking water procurement and the needs of the increasingly intensified agricultural production in West Germany are discussed. Within the federal government there is a large gap between the officially proclaimed goals of environmental protection within agricultural policy and the actions of that policy. Strategies and instruments for agricultural land use compatible with water procurement are presented. These include planning to determine the suitability of land for specific types of agriculture based on hydroecological mapping, field clearing to match land and agricultural type, the promotion of agricultural businesses prepared to forego intensification and their financial compensation in the case of lost revenues, the laying fallow of land, the building up of an advisory structure particularly for the subjects of fertilizers and pesticides, aid in marketing of goods produced under conditions favorable to water procurement, and development of a national price policy. All these measures should be carried out within the context of water priority areas which already exist in some regions of the country. However, it will be difficult to persuade the government to institute such a program due to the lobbying power of the agricultural industry. (Gish-FRC)
W82-06714

6G. Ecologic Impact Of Water Development

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
R. G. White, J. H. Milligan, A. E. Bingham, R. A. Ruediger, and T. S. Vogel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243478, Price codes: A13 in paper copy, A01 in microfiche. Report, September, 1981. 283 p, 74 Fig, 37 Tab, 124 Ref, 6 Append. OWRT B-045-IDA(1). 14-34-0001-8080.

Descriptors: *Stream discharge, *Hydraulic models, *Model studies, *Instream flow, *Fish populations, Streamflow, Streamflow depletion, Flow discharge, Flow characteristics, Flow channels, Hydraulic similitude, Simulation, Aquatic habitats, Channel flow, Channel morphology, Insect behavior, Population dynamics, Riffles, Fish migration, Trout, Oregon, Grande Ronde River.

A study was made of the responses of aquatic insects and juvenile rainbow-steelhead trout to flow-related changes in habitat, and of the predictive capability of three hydraulic simulation models that are currently used to make instream flow recommendations. Tests were conducted in the spring, summer, and fall in two large near-natural artificial stream channels having run-riffle

channel configurations: one channel was maintained at constant discharge; flow in the second channel was reduced incrementally. Flow reduction produced increased behavioral/catastrophic insect drift which increased at night and varied with season, degree of flow reduction, and type and developmental stage of aquatic insects. Flow reduction also resulted in decreased trout numbers with large test fish more affected than small fish. It appeared that larger trout responded primarily to physical habitat parameters than to a decrease in food availability. No single hydraulic parameter studied (velocity, depth, surface area, wetted perimeter), consistently correlated with test fish response. Flow-related changes in cover, however, appeared to influence juvenile trout habitat utilization. The hydraulic simulation models tested generally predicted the parameters they were designed for accurately, but the models varied in ease of calibration, application, and useful extrapolation range. It was found that transect placements for hydraulic simulation data collection in run-riffle channels were more important than the number of transects used. (Zielinski-MAXIMA)
W82-05923

CARRYING CAPACITY FOR THE ILLINOIS RIVER,
Oregon State Univ., Corvallis. School of Forestry.
B. Shelby, and R. B. Colvin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243510, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 56 p, 12 Tab, 4 Append. OWRT A-999-ORE(28).

Descriptors: *Wild rivers, *Camp sites, *Public waters, *Carrying capacity, *Frequency analysis, Rivers, Rapid flow, Boating, Boat-launching ramps, Recreation wastes, Navigable rivers, Public access, Public waters, Environmental effects, *Oregon, *Illinois River(Oregon).

A total of 51 miles of the Illinois River in southwestern Oregon has been proposed for inclusion in the Wild and Scenic Rivers system; this study focused on the use of the 29-mile wild section between Briggs and Nancy Creeks for wild river excursions. These trips last from 2-5 days, with an average trip size of 7 persons for private and 11 persons for commercial groups, covering a season from early March to mid-June. The physical capacity of the river is limited by available campsites; ecological capacity particularly concerns human impacts on campsite ecology; social capacity, the limiting factor, focuses on experience factors among groups. The field study measured use levels, encounters among parties, and selected user perceptions. During the mid-April to early June 1979 study period, 50% of the days had no launches, and 59% of launch days were Fridays and Saturdays. With 1 or 2 trips launching per day, party encounters ranged from 0-2/day; with 3-5 launches, encounters increased to 1-3/day. Trips spent an average of 1 of 7 nights (16%) within sight/sound of another party. It was concluded that camp encounters are not correlated with use level; competition for campsites occurs in particular sections of the river, the location of which depends on the length of the trips. (Zielinski-MAXIMA)
W82-05927

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W82-05933

CHINA'S AGRO-ECOSYSTEM,
Manitoba Univ., Winnipeg. Dept. of Geography.
For primary bibliographic entry see Field 3B.
W82-06019

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.
Department of Energy, Washington, DC.
Report DOE/EIS-0082, February, 1982. 575 p, 31 Fig, 104 Tab, 221 Ref, 17 Append.

Descriptors: *Radioactive waste disposal, *Environmental effects, *Environmental impact statement, *Underground waste disposal, Wastewater treatment, Sludge disposal, Waste disposal, Radioactive wastes, *South Carolina, *Savannah River Plant.

The Savannah River Plant is a major installation for the production of nuclear materials for national defense. Approximately 8300 cu m (22 million gal) of high-level radio-active waste (HLW) are currently stored in tanks at the plant. The purpose of this study is to provide environmental input into both the selection of an appropriate strategy for the permanent disposal of the HLW currently stored at the plant and subsequent decision to construct and operate a Defense Waste Processing Facility (DWPF) at the Savannah River Plant site. The proposed DWPF would process the liquid HLW generated into a stable form for ultimate disposal. The HLW is composed of three components: an insoluble sludge 15%; a crystallized salt cake (60%); and a supernatant aqueous solution (25%). The preferred alternative for disposal of the HLW is geological disposal or long-term isolation in a mined geologic repostitory, with very deep hole and subseabed disposal being retained as backup technologies. The proposed DWPF will immobilize the waste into an appropriate form for placement in a repository. Three immobiliazation alternatives were analyzed in detail to show the possible range of environmental impacts associated with the construction and operation of a DWPF. All three immobiliaztion alternatives require the processing of the waste into two fractions: a high-level raioactivity fraction for immobilization and offsite geologic disposal and a partially decontaminated salt fraction for solidification and disposal as low-level waste on the site. The preferred alternative is the staged process alternative in which a facility to treat the sludge would be constructed first, and then a facility to treat the salt cake and supernatant would be constructed. (Moore-SRC)
W82-06087

EVALUATION OF IMPACTS ASSOCIATED WITH REREGULATION OF WATER LEVELS IN LAKE MOHAVE,
Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 4, March 1980. 23 p, 8 Fig, 4 Tab, 8 Ref. 14-06-30002218.

Descriptors: *Lake Mohave, *Reservoir releases, *Water level fluctuations, *Thermal stratification, *Fish populations, *Environmental effects, Hoover Dam, Recreation, Water temperature, Plankton, Hydroelectric plants, Reservoir operation, Reservoir fisheries, *Nevada.

The Water and Power Resources Service is considering reregulating Lake Mohave water levels to increase the net power benefit from Hoover Dam. By generating more power during those periods when energy has a higher market value, more net monitary benefit can be derived. To optimize power generation from Hoover Dam, water levels will fluctuate from elevations of 600 to 640 ft. The proposed alternatives will increase the instability of Lake Mohave, which in turn will affect every component of the biota. It is reasonably certain that the largemouth bass fishery will decline as a result of the reregulated water levels. The lower water will also tend to reduce the total carrying capacity of Lake Mohave for all types of fisheries. Fluctuating water levels and high Hoover Dam discharges, during low water levels, will increase the instability in Lake Mohave resulting in partial destratification and cooler water temperatures. Instability will produce changes in the plankton communities, but nuisance conditions will probably not occur due to increased turbulence and lower water temperatures. Cooler water temperatures can be considered a water quality problem because the total area in Lake Mohave available for water contact sports will be reduced. (Moore-SRC)
W82-06089

THE LIMNOLOGICAL STATUS OF LAKE MEAD AND LAKE MOHAVE UNDER PRESENT AND FUTURE POWERPLANT OPERATIONS OF HOOVER DAM,
Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, J. R. Baker, and J. E. Deacon.
Technical Report No 1, January 1980. 229 p, 70 Fig, 27 Tab, 2 Ref. 14-06-300-2218.

Descriptors: *Lake Mead, *Lake Mohave, *Dam effects, *Reservoir releases, Limnology, *Pumped storage, Hydroelectric plants, Reservoir operation, Nutrients, Physical properties, Chemical properties, Plankton, Productivity, Environmental effects, Thermal stratification, Water temperature, Fisheries, *Utah.

Several proposed alternatives for modifying Hoover Dam to increase peak-power output would require a peak discharge in excess of current levels (25-30,000 cu ft/sec). Investigations were conducted on Lake Mead and Lake Mohave to assess the impacts of these power modifications on the limnology of the reservoirs. Temperature, oxygen, pH, conductivity, light, nitrogen, phosphorus, chlorophyll-a, phytoplankton productivity, and plankton species composition measurements were made monthly at 15 reservoir stations in Lake Mead and 5 in Lake Mohave. Nutrients were also measured monthly in the Colorado River at Pierce Ferry and below Hoover Dam and in Las Vegas Wash. Upgrading of existing generating units or addition of new units will require an increase in peak-discharge to 49,000 and 56,000 cu ft/sec and minimum flows of 2000 cu ft/sec. Alternating high and low discharge will cause an oscillation of the thermocline in Black Canyon, near the dam. At low lake elevations, warmer water will probably be pulled to the intake gates, increasing the temperatures of the discharge. The alternating high and low discharge will have the greatest impact on Lake Mohave. Thermal stratification will be disrupted, and the interface between river and reservoir water will shift down-lake under high discharge and up-lake at low discharge. Operation of a pump-storage unit at Hoover Dam will require a peak-discharge of 76,000 cu ft/sec, periods of no flow and reverse flows of 25,000 cu ft/sec. Fluctuations in temperature of the river, interspersed with periods of no flow will create problems for recreational use and fisheries in Black Canyon between Hoover Dam and Willow Beach. (Moore-SRC)
W82-06090

INFLUENCE OF DREDGING AND HIGH DISCHARGE ON THE ECOLOGY OF BLACK CANYON,
Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, T. G. Miller, and J. R. Baker.
Technical Report No 1, 1980. 59 p, 16 Fig, 8 Tab, 33 Ref. 14-06-300-2218.

Descriptors: *Forebays, *Dredging, *Environmental effects, *Reservoir releases, *Productivity, Fish food organisms, Dam effects, Hydroelectric plants, Colorado River, Hoover Dam, Pumped storage, Periphyton, Invertebrates, Scour, Silting, Trout, Sucker, Chubs, *Black Canyon, *Utah.

The Water and Power Resources Service is considering dredging in Black Canyon to create a larger forebay to accommodate higher peak-discharges and reverse flows for proposed modifications to Hoover Dam, such as the addition of one or more conventional hydroelectric generating units, and the addition of reversible pump-storage hydroelectric units. The Black Canyon area supports a heavily utilized trout fishery and is important habitat for the razorback sucker and possibly bonytail chub. The food chain in Black Canyon is relatively simple and consists of a few invertebrate and fish species that are wholly supported by periphyton productivity occurring in the canyon. Dredging in the area above Ringbolt Rapids will significantly reduce periphyton and invertebrate productivity, and could reduce the trout and endemic fish populations because they are wholly dependent on these autochthonous resources for

food. Higher current velocities created by increased peak-discharges could have a mre permanent impact than dredging. Siltation occurs below the tailrace during low discharge periods. These materials are flushed downstream during peak-discharge periods and scour the bottom of periphyton and invertebrates. If dredging is conducted, consideration should be given to disposal of dredge spoils (cobble and boulder size) along the river banks in Black Canyon, since boulder and cobble substrate would probably enhance productivity. (Moore-SRC)
W82-06091

EVALUATION OF POSSIBLE TEMPERATURE FLUCTUATIONS FROM PROPOSED POWER MODIFICATIONS OF HOOVER DAM,
Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 3, March 1980, 23 p, 10 Fig, 2 Tab, 4 Ref. 14-06-30002218.

Descriptors: *Water temperature, *Dam effects, *Environmental effects, *Pumped storage, *Reservoir operation, Reservoir releases, *Hoover Dam, Hydroelectric plants, Lake Mead, Thermal stratification, Intakes, *Utah.

Planned alternatives for increasing the generation capacity of Hoover Dam to help meet peak power demands include uprating existing units, adding generating units, and adding reversible pumped-storage hydroelectric units. The upper intake gates (1045 ft), with few exceptions, have not been used since 1954, but with the addition of generating units or the installation of reversible pumped-storage units, one upper gate on the Arizona Tower would be used in conjunction with the four lower gates to facilitate the higher flows. In order to evaluate the effects of discharge rate from the upper and lower gates on temperature and temperture structure in Lake Mead, Hoover Dam was alternately operated from the four lower gates and four upper gates in sonsecutive 24-hour periods over the daily power cycles on 18-19 August and 22-23 August 1979. The rate of discharge had no obvious effect on discharge temperatures when either the lower or upper gates were used. The planned operation of using one of the upper gates in conjunction with the four lower gates will cause only a slight increase in discharge temperature. The cumulative effect of continual alternation of pumping and discharging with reversible pumped storage could substantially disrupt thermal stratification in Black Canyon and parts of Boulder Basin. (Moore-SRC)
W82-06092

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,
Windrem, Feeney and Williams, Lakeport, CA.
P. F. Windrem, and G. L. Marr.
Natural Resources Lawyer, Vol 14, No 4, p 675-685, 1982. 1 Tab, 58 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, *California, Geysers, Water quality, Water pollution sources, Environmental effects.

This paper describes the stages of geothermal development, the attendant environmental hazards, and the jurisdictions of the various government agencies. Most examples of environmental hazards are drawn from the electric power production in the geysers of northern California. Major environmental effects of geothermal development are observed on air quality, land (soil erosion, seismic activity and subsidence, wildlife habitat and visual quality), and water quality. In California development occurs on private lands, federal land, federal mineral reserve land, state land, and state mineral reserve land, each subject to different regulatory agencies. Geothermal development occurs in five stages: exploration, full field development, power plant construction, field operation, and field abandonment. Primary threats to water quality are sedimentation of streams from soil erosion caused by earth work, spills of liquid wastes such as drilling fluids and power plant steam condensate, and well casing failure. The most serious incidents of water pollution at the geysers in California have resulted from spills of steam condensate into nearby streams, caused by condensate pond overflow, condensate pipeline rupture, or reinjection problems. The pollution results from the toxicity of the waste water. A number of different agencies have jurisdiction over various aspects of the process. (Baker-FRC)
W82-06217

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.
Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 6B.
W82-06368

THE RELATIVE ABUNDANCE OF OPOSSUM SHRIMP, MYSIS RELICTA, IN TWIN LAKES, COLORADO USING A BENTHIC TRAWL,
Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234493, Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-82-3, September 1981. 25 p, 12 Fig, 5 Tab, 17 Ref.

Descriptors: *Shrimp, *Biological samples, *Sampling, Aquatic populations, Twin Lakes, *Pumped storage, Environmental effects, Benthos, Trawling, Seasonal distribution, *Colorado.

The study of the opossum shrimp (Mysis relicta Loven) at Twin Lakes, Colorado, is part of an investigation into the potential impacts of pumped-storage power generation on the two lakes. Since 1974, large and small benthic sled-type trawls have been used monthly to determine relative abundance of the shrimp. A comparison of the two trawls based on replicate sampling indicated that the mean shrimp density for the large trawl was 68% of the small trawl estimate. This difference was not statistically significant because of a large sample variation. An off-bottom sampling bias affected by the speed of the trawl was determined in a separate study using the small trawl. Corrections for this potential bias in the small trawl data collected in 1977 and 1979 indicated that shrimp densities may have been underestimated by 22 to 77%. Comparison of mean shrimp densities for the two trawl sizes using corrected small trawl data showed the large trawl estimate to be only 42% of the small trawl estimate. Shrimp length frequency analyses concur with this difference, indicating the smaller, juvenile shrimp were missed by the large trawl because of the larger mesh size. Adjusting for trawl sampling efficiency and sampling bias, yearly shrimp densities may have ranged from 88 to 348 shrimp/sq m in the lower lake and from 57 to 174 shrimp/sq m in the upper lake. This sampling variability precluded all but the most general comparisons of Mysis densities. Monthly estimates of shrimp densities in each of 4 years sampled showed a characteristic increase from June to September with declines in October and November in the lower lake. Over the 1974 to 1979 study period, seasonal mean estimates of shrimp density and indicated an increasing abundance of Mysis since 1975 in the lower lake, and a fluctuating population in the upper lake. (Author's abstract)
W82-06399

TWIN LAKES STUDIES: A CHARACTERIZATION OF THE TWIN LAKES FISHERY VIA CREEL CENSUS WITH AN EVALUATION OF POTENTIAL EFFECTS OF PUMPED-STORAGE POWER GENERATION,
Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Bureau of Reclamation Report REC-ERC-82-4, November 1981. 56 p, 12 Fig, 28 Tab, 42 Ref.

Descriptors: *Environmental effects, *Trout, *Lake fisheries, Twin Lakes, *Pumped storage, Fish populations, Sport fishing, Recreation, Fishkill, Turbidity, Water level fluctuations, *Colorado.

Creel census data are presented for the period December 1976 to September 1979. The creel census studies have resulted in estimates of seasonal fisherman effort, harvest, and catch rates with a precision suitable for use in the detection of impacts from the operation of the Mt. Elbert Pumped-Storage Powerplant. For the 1973-79 summer seasons, total fishermen effort estimates ranged from 66,677 to 89,820 man-hours on the lower lake and from 19,721 to 29,139 man-hours on the upper lake. Harvests ranged from 19,955 to 32,496 fish on the lower lake and from 6411 to 12,457 fish on the upper lake. Fifty-four to 56% of the fisherman effort and harvest occurred on weekends. Rainbow trout composed 94% or greater of the summer harvests. For the winter seasons on the lower lake from 1974 to 1979, fishermen effort estimates ranged from 3900 to 8800 man-hours and harvest estimates ranged from 400 to 1200 fish. Lake trout composed 87% or greater of the harvests in most winter seasons. Potential powerplant impacts via increased mortality to rainbow trout, daily and seasonal water-level fluctuations, and shoreline turbidity may have the greatest negative impact upon the Twin Lakes shore fishery for rainbow trout. Because the estimates from the winter harvest, the boat fishery, and the monthly creel census for both shore and boat categories are less precise, only large-scale changes in these components will reflect statistical significance. Operation of the powerplant during the weekends in the summer may have a greater impact on fishermen effort if large-scale turbidity or fishskills are observed. (Moore-SRC)
W82-06401

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES AT TWIN LAKES, COLORADO; 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit., Fort Collins.
E. P. Bergersen, and M. Maiolie.
Bureau of Reclamation Report REC-ERC-82-8, December 1981, 66 p, 40 Fig, 2 Tab, 18 Ref, 1 Append.

Descriptors: *Environmental effects, *Water currents, *Limnology, *Trout, *Water level fluctuations, *Shrimp, *Suspended sediments, *Twin Lakes, *Pumped storage, Monitoring, Water circulation, Spawning, Fish eggs, Eutrophication, Vegetation, Productivity.

The objectives of these studies were to gather baseline data on the Twin Lakes system during the preoperational phase of the Mt. Elbert Pumped Storage Powerplant, and to develop aquatic environmental monitoring techniques suitable for use during post-construction operating periods. Natural, seasonal patterns in surface and bottom currents were characterized and documented in the two-lake system, to allow detection of changes in current patterns produced by the powerplant. Suspected shoreline spawning habitats were searched for lake trout eggs to a depth of 1.5 m in 1979 and 1980. Results indicate that it is unlikely that lake trout in Twin Lakes spawn in water less than 1.5 m deep, and thus the expected daily water fluctuation of 0.7 to 1.1 m should not result in the exposure of lake trout eggs. A photographic method of estimating Mysis shrimp populations was developed. Shrimp are at least 2.4 times as abundant in Twin Lakes as previously thought, with densities in the vicinity of the powerplant as high as 232 shrimp/sq m. Both sediment traps and inflow/outflow suspended sediment sampling were used to estimate sedimentation rates in Twin Lakes. Estimates from these two methods differ greatly. The best time to monitor impacts on sediment movement and deposition would be during the winter months. Potential input to the energy budget from inundated terrestrial vegetation was estimated to be over four times the average annual primary productivity of the system. (Moore-SRC)
W82-06402

ENVIRONMENTAL ASSESSMENT; GEOTHERMAL DIRECT HEAT PROJECT; MARLIN TEXAS.
Department of Energy, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EA-0117, Price codes: A04 in paper copy, A01 in microfiche. Report DOE/EA-0117, August 1980. 68 p, 11 Fig, 14 Tab, 10 Ref, 2 Append.

Descriptors: *Geothermal resources, *Environmental effects, *Wastewater disposal, *Brazos River, Wells, Water quality, Groundwater pollution, Water pollution sources, Thermal pollution.

The project construction activities consist of well drilling, pipeline construction, heating system modification, and fluid disposal provision for the Torbett-Hutchings-Smith Memorial Hospital to provide an environmentally acceptable, operational geothermal space heating and hot water system. It was necessary to drill one supply well in order to confirm the reservoir and to obtain fluids for analysis in order to assess the environmental effects of fluid disposal. Fluid from operation will be disposed of by discharging it directly into existing street drains, which will carry the fluid to Park Lake and eventually the Brazos River. The spent fluids will be discharged at approximately 50 C and at a maximum of 13 l/s. It is anticipated that because of the utilitarian nature of the City Park Lake, Bean Branch and McCullough Slough; the long-term public use and acceptance of Marlin geothermal waters for bathing and drinking purposes; and the fact that these bodies of water are not used for irrigation, the geothermal discharge will not require pretreatment. No significant effects on water quality in the project area are expected during operation. At minimum flow rate for the Brazos River, the maximum discharge of geothermal water (25 l/s) will increase the river's flow by only 0.26%. The possibility of contamination of aquifers will be minimized through careful design and construction of the well. Depletion or subsidence problems are not likely to occur. The proposed drilling site is in a developed urban area, so no disturbance of natural vegetation or wildlife habitat will occur. (Moore-SRC)
W82-06404

ENVIRONMENTAL ASSESSMENTAL, GEOTHERMAL ENERGY, HEBER GEOTHERMAL BINARY-CYCLE DEMONSTRATION PROJECT; IMPERIAL COUNTY, CALIFORNIA.
Department of Energy, Washington, DC. Div. of Geothermal Energy.
Report DOE/EA-119, October 1980. 314 p, 25 Fig, 18 Tab, 173 Ref, 9 Append.

Descriptors: *Geothermal power, *Environmental effects, *Cooling water, *Injection wells, Wastewater disposal, Irrigation-return flow, Powerplants, Water use, Effluents, Salt drift, Thermal pollution, Irrigation water, Blowdown.

The power plant will utilize a simple binary conversion process consisting of three fluid loops: a geothermal fluid loop, a hydrocarbon working fluid loop, and a cooling water loop. The geothermal well field will consist of a production island with 13 production wells and an injection island with 7 injection wells. A mechanical draft cooling tower using approximately 8.8 cu m/s of cooling water will be utilized. Approximately 0.22 cu m/s of make-up water is required by the project. Water for the first five years of operation will be Colorado River irrigation water obtained from the Imperial Irrigation District. After the initial five years of operation, water will be obtained from the New River, irrigation return flows, or both. The geothermal resource to be developed is located at a depth of 610 m to 3048 m. The available resource is estimated to be 17 cu km at temperatures ranging from 165 C to 182 C. The principal effluents are salt drift and blowdown released from the cooling tower. Geological impacts resulting from the project are gradual reservoir depletion, and displacement of prime farmland soils. Hydrological impacts result from water depletion, effluent discharge, and thermal enrichment. These impacts will be mitigated by compliance with California Regional Water Quality Control Board permit requirements. (Moore-SRC)
W82-06406

GOWANUS CREEK CHANNEL; BROOKLYN, NEW YORK; REVIEW OF REPORTS (SURVEY); MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT.
Army Corps of Engineers, New York.
Report, September 1981. 81 p, 6 Fig, 10 Tab, 25 Ref.

Descriptors: *Dredging, *Channel improvement, *Waterways, *Environmental impact statement, Oil spills, Turbidity, Estuaries, Environmental effects, Sediments, Fish migration, Water quality, Water pollution control, *New York, Gowanus Creek Channel.

The 30 ft mean low water existing Federal navigation channels in Gowanus Creek, Brooklyn, New York, are not deep enough to allow present deep draft and other large ocean-going vessels to use them in a fully loaded condition. The recommended plan consists of deepening the channels to 35 ft below mean low water. Additional dredging from 35 to 40 ft may be accomplished at non-Federal cost. All material would be disposed of in a sanitary land fill in Fresh Kills, Staten Island. The dredging will significantly reduce present navigation problems in this waterway, with minimal adverse environmental impact and an overall net improvement due to removal of polluted bottom sediments from the aquatic environment. It will also reduce the occurrence of oil spills by reducing the lightering of petroleum products. Since Gowanus Creek Channel is impoverished in aquatic and benthic life, and because the surrounding area is devoted to shipping and industrial activities, the environmental impact of dredging will be minimal. An increase in turbidity in Gowanus Bay may marginally interfere with fish migrations. The impact of dredging on the Hudson fishery will be reduced if dredging activities are limited to the late autumn or early winter. Indications are that there will be no change in the tidal dynamics of the creek. (Moore-SRC)
W82-06407

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.
Soil Conservation Service, Boise, ID.
Report, March 1982. 98 p, 23 Fig, 14 p, 34 Ref, 2 Append.

Descriptors: *Channeling, *Stream stabilization, *Environmental effects, *Flood damage, *Aquatic habitats, Invertebrates, Dam failure, Species diversity, Irrigation water, Trout, Productivity, *Idaho, Teton River.

Teton Dam collapsed on June 5, 1976, while it was being filled for the first time. The North Fork of the Teton River was badly damaged by the flooding. In August 1976, water was diverted from the North Fork to facilitate the clean-up operation and restore its capacity for carrying flood flows. The stream-bed remained dry until mid-December when the temporary diversion dam was removed. A study was initiated to determine the effect of the Teton Dam flood and subsequent channel dewatering and channelization on the North Fork. Four stations in the North Fork were established as routine sample locations, plus one station in the main river. Examination of the data on total numbers of benthic invertebrates indicates that at least some parts of the North Fork have recovered. Its failure to do so at one station is due to excessive withdrawal for irrigation and not to factors associated with the flood. Data on the number of taxa suggested that only one station on the North Fork had fully recovered in terms of richness and that the other stations support 8 to 26 taxa fewer than would be expected. Values for richness and diversity did not peak until the second year at the downstream stations. There are steps which could have been taken as a part of the channel rehabilitation project which would have enhanced the rate of recovery and level of productivity. Failure to do so has prevented recovery of this portion of the river even three years later, and the attainment of its full potential as a productive trout stream. (Moore-SRC)
W82-06409

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,
Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
J. E. Peters, and L. J. Bergen.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 217-233, June, 1982. 4 Fig, 8 Tab, 4 Ref.

Descriptors: *Reservoir operation, *Environmental effects, *Hydroelectric plants, Reservoir releases, St. Croix River, New Brunswick, Maine, Water supply, Rivers, Water use, Shores, Erosion, International Joint Commission, Spednic Lake, Flow regulation, Water level fluctuations, Fish, Wildlife, Attitudes, Public opinion, Model studies, Georgia Pacific Corporation, Vanceboro Dam.

The St. Croix River, which straddles the international border between Maine and New Brunswick, was the scene of water use conflicts in the early 1970's. Residents and camp owners on Spednic Lake complained about adverse effects of hydropower practices on recreation, water supplies, and shorefront properties. Among the problems cited were wrecking of boats on boulders during low water, reduction in fish numbers, poor access to the lake during low water periods, serious bank erosion, debris accumulation, dry wells in summer, and unreliable flows downstream of the dam. The International Joint Commission initiated studies to determine the effects of changes in the level of Spednic Lake and the flow fluctuations immediately downstream of the lake's impoundment, Vanceboro Dam. The system is operated by the Georgia Pacific Corporation for hydroelectric power production. The study included a public attitude survey, modeling of alternative operating procedures, and an independent study by the Georgia Pacific Corporation's consultants. A new operating procedure based on a rule curve was agreed upon. This guarantees certain minimum flows and lake levels near to the desirable summer level of 378.5 ft. Provisions were made to store sufficient water to compensate for a loss of capacity in a thermal plant in the system. The new operating procedure produces more favorable summer water levels in the lake and higher streamflows for water quality and fish. No major complaints from the public of government agencies have been received since the new operating policy has been instituted. (Cassar-FRC)
W82-06429

THE LANDSCAPE OF RUTLAND WATER,
S. Crowe.
Hydrobiologia, Vol 88, No 1-2, p 43-46, March, 1982.

Descriptors: *Reservoir, *Water supply, *Land management, *Design criteria, *Planting management, Drawdown, Land use, Zoning, Land resources, Forest management, Forest watersheds, Recreation, Wilderness areas, Water sports, Rutland Water, England.

Landscape problems encountered at Rutland Water included reconciliation of the reservoir and its works with the rural surroundings, siting and treatment of all ancillary works, mitigation of exposure of shore line by drawdown, provision of opportunities for recreation without damage to the environment, and nature conservation. The means adopted to solve these problems were forward planning, consultation with all interests concerned, extensive planting of native species, and arrangemens for appropriate maintenance. The landscaping process began with an extensive survey of the character of the site. Fortunately, reservoir topography resulted in a diversified shape of acceptable scale. Special attention was paid to avoiding incongruities caused by drawdown, and long dam, the pumphouses, and the canalized stream below the dam. To minimize time and cost of maintenance, most of the perimeter land is either grazed by sheep or maintained as woodland. (Titus-FRC)
W82-06478

POWER PLANT SITING,

Ebasco Services Inc., Greensboro, NC.
N. R. Tilford.
Bulletin of the Association of Engineering Geologists, Vol 19 No 2, p 187-196, 1982. 4 Tab.

Descriptors: *Site selection, *Powerplants, *Decision making, Nuclear powerplants, Hydroelectric plants, Electric powerplants, Water use, Water requirement, Thermal pollution, Environmental effects, Pumped storage, Water pollution effects, Reservoirs, Cooling water, Land use, Flood forecasting, Aquatic life, Licenses, Dams.

Water is the main requisite involved in siting any powerplant, hydroelectric, nuclear, or fossil-fueled. The ideal hydroelectric plant is located close to consumers in a high narrow gorge immediately downstream from a large valley. The best rock formations are massive, strong, and impermeable. Pumped storage facilities should meet the same requirements as the primary reservoir, but the effects of the daily or weekly filling and draining cycle must be considered. Cooling water is important in fossil-fueled electric plants, particularly coal-fired plants. For example, a 600 MW coal-fired plant uses 20 cu ft of water per sec. This water is returned to the biosphere at temperatures 8-15 F above ambient intake temperatures, possibly causing unfavorable environmental effects. Other siting factors for a coal-fired plant are transmission distance, fuel handling facilities, and waste disposal space. A method for siting electric plants is introduced. This is based on a series of criteria: exclusion criteria, avoidance criteria, and prefeence criteria, which can be applied to any geographical area. The system is weighted to help quantify the many subjective decisions. The procedure is illustrated in an evaluation of a nuclear power plant site. Candidate sites are graded on a scale of 100 with respect to engineering cost related items, nuclear licensing considerations, and environmental considerations. Among the water-related factors in the nuclear licensing category are meteorology, relative weight, 10% of total; hydrology, 10%; and depth to groundwater (a consideration under geology and seismology), 60%. Environmental considerations include aquatic ecology, relative weight, 35%; terrestrial ecology, 15%; ocean hydrogynamics, 35% (including heat dispersion capability of a water body and recirculating potential), and fresh water use, 15%. A numerical score derived for each site allows easy ranking of possible sites. (Cassar-FRC)
W82-06555

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,
Geological Survey, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06677

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,
Southeastern Forest Experiment Station, Asheville, NC.
For primary bibliographic entry see Field 5C.
W82-06966

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
E. R. Harris.
Report, April, 1981. 39 p, 1 Fig, 18 Ref.

Descriptors: *Cloud seeding, *Snowpack, *Environmental effects, *Water yield improvement, *Colorado River Basin, Orographic precipitation, Weather modification, Water resource development, Streamflow, Runoff, Flood control.

The action proposed is to seed winter storm clouds in the Rocky Mountains of the Colorado River Basin to increase snowpack, runoff, and streamflow, thereby providing increased water yield to help meet future resource demands. Proposed alternatives include: no action: a 10-year program, with an initial 5-year phase for tests in two subbasins followed by a 5-year randomized seeding program; an 8-year program in which the initial phase is reduced to 3 years; and a 6-year program with a 2-year initial phase followed by a 4-year second phase. In each of the cloud seeding options, the initial phase involves installation of meteorological and hydrological observation and data collection networks. Seeding opportunity, climatological studies, seeding mode studies, and ground-based seeding studies would be included in the initial phase for the 10-year and 8-year options. No significant impact is expected from the initial phase. Each of the three cloud seeding options includes a second, randomized demonstration phase. An operational winter cloud seeding program could result in a 10 to 15% percipitation increase. Avalanche conditions and flood hazards will be included in suspension criteria for this project. It is expected that the use of seeding agents in this precipitation management research will have no environmental impact. A Finding of No Significant Impact for the Design Phase of the Colorado River Enhanced Snowpack Test is included. (Moore-SRC)
W82-06967

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. P. Musatov, G. F. Krasnozhon, and E. A. Fedoseev.
Water Resources, Vol 8, No 4, p 341-354, July/August, 1981. 5 Fig, 4 Tab, 33 Ref. Translated from Vodnye Resursy, No 4, p 21-37, July/August, 1981.

Descriptors: *Water management, *Fish management, *River regulations, Ecological effects, Volga Delta, North Caspian Sea, Fisheries, Deltas, Spawing, Water distribution, River flow, Salinity, Runoff, Productivity, Sturgeon, Fish passages, Canals, Aquatic habits, Reservoir releases, Estuarine environment, Estuaries, *USSR, Environmental effects, Flow control, Water resources development.

The North Caspian Sea and the Volga, Ural, and Terek basins should be considered as a single biome for the purposes of water management, according to a review of published data. Factors affecting fish reproduction and growth and allowing water regimes to achieve optimum development of fisheries are discussed. In the Volga delta the regulation of river runoff has changed the location and character of the fish spawning grounds, has caused the dates of the maximum and the end of the flood cycle to occur significantly earlier, has lowered the temperature of runoff, and has significantly decreased the abundance of fish caught in the region. In the North Caspian Sea salinity regimes are affected by river regulation. Productivity of the deep zones increases during wet years, and productivity in the shallow zone increases during dry years. Proper operation of the water distributor at the apex of the Volga delta is suggested for regulating the ecosystems in this region. This would increase freshening of the North Caspian waters and preserve the habitat for the brackish water complex of fish. Although operating the distributor disturbs the sturgeon migration, the author feels that these problems can be solved by fish passages, large scale transportation of spawners upstream, and changing the balance of releases between eastern and western parts of the Caspian. River regulation has also changed the physical nature of the Volga delta and lowered the level of the Caspian Sea. The number of distributary channels has doubled since 1912, reducing current velocity, increasing siltation and shoaling, salinizing the estuarine nearshore zone, and destroying connections between the sea and some fishways. Specific suggestions for improving the flow to the eastern fishways of the Volga are given. These include construction of additional canals. (Cassar-FRC)
W82-06985

7. RESOURCES DATA

7A. Network Design

LEAK LOCATION ENTERS COMPUTER AGE,
New York City Dept. of Environmental Protection, Bureau of Water Supply.
D. S. Greeley.
American City and County, Vol 97, No 5, p 14, 17, 18, May, 1982. 3 Fig.

Descriptors: *Water conservation, *Leakage, Water loss, *New York City, Measuring instruments, Water distribution.

With drought conditions facing New York, the city turned to the use of a computerized leak detection patrol to stop wastage of valuable water. After it had been in use for one year, the method had located some 43 mgd in leaks. When the first mobile leak detection van arrived in December of 1980 the manufacturer provided an intensive classroom training session to familiarize the laborers with the New York City water supply system, fundamentals of leak detection, and the principle behind the leak location system. The equipment provided so useful that three more leak detection vans were purchased in June of 1981 as the drought conditions intensified. The leak detection unit is about the size of a portable radio and allows a surveyor to listen to live valves, hydrant valves, and service lines along a water main. When a leak noise is picked up, the surveyor brackets the leak by identifying the points of maximum noise on the main. He then marks the distribution system map and continues surveying. The maps of each surveyor are referred to a follow-up crew in a leak detection van which wires the transducer connections into the console inside the van. By use of a microprocessor and oscilloscope and knowing the diameter of the water main the operator in the van can pinpoint the precise location of the leak. The savings of 43 mgd represented more than 500 leaks. (Baker-FRC)
W82-06018

WATER-QUALITY ASSESSMENT OF CACHE CREEK, YOLO, LAKE, AND COLUSA COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. K. Sorenson, and A. L. Elliott.
Geological Survey Open-File Report 81-677 (WRI), July 1981. 41 p, 14 Fig, 1 Plate, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Water quality standards, *Data collections, *Water supply, Water use, Surface water, Streamflow, Suspended sediments, Sampling, Monitoring, Sites, Dissolved oxygen, Pesticides, Potential water supply, *California, Cache Creek, Clear Lake, Yolo Bypass.

Cache Creek and its tributaries from Clear Lake to Yolo Bypass have been the subject of quality and quantity of water studies by several governmental agencies since the early 1900's. Water-quality data from these studies showed that water in the basin is of good quality for most of the beneficial uses defined by the California State Water Resources Control Board. Concentrations of dissolved constituents are substantially higher in the water in the two largest tributaries than in Cache Creek. Seasonal variations in dissolved constituents are also greater in the tributaries than in Cache Creek. Clear Lake has a major effect on water quality, resulting in little seasonal fluctuation in water quality in Cache Creek. Excessive voron and suspended-sediment concentrations are the greatest water-quality problems, according to existing data. Both of these problems are from natural sources. Water-quality monitoring is presently being conducted monthly at four sites by the California Department of Water Resurces and at several other sites by other agencies. Modifications in current monitoring are proposed to gain further information on diel dissolved-oxygen cycles, pesticides, and bio-

logical constituents that may adversely affect beneficial uses. (USGS)
W82-06130

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,
CH2M/Hill, Atlanta, GA.
For primary bibliographic entry see Field 5A.
W82-06235

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,
Missouri Univ., Kansas City. Dept. of Geosciences.
For primary bibliographic entry see Field 6A.
W82-06552

THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,
Department of the Environment, Reading (England). Water Data Unit,
For primary bibliographic entry see Field 7C.
W82-06591

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Robison, L. S. Forcella, and M. W. Gannett.
Open-File Report 81-1002, 1981. 24 p, 3 Fig, 1 Tab.

Descriptors: *Data collections, *Geothermal studies, *Test wells, *Drillers logs, Temperature, *Oregon, Mount Hood.

This report includes well specifications, drillers' logs, and temperature logs of geothermal test wells drilled at 7 sites near Mt. Hood, Oreg. The wells were drilled in 1979 and 1980 under contract to the U.S. Geological Survey. The project, funded by the U.S. Department of Energy, was part of an interagency effort to determine the geothermal potential of Mt. Hood. The agencies involved were, U.S. Department of Energy, U.S. Forest Service, U.S. Geological Survey, and Oregon Department of Geology and Mineral Industries. (USGS)
W82-06950

7B. Data Acquisition

LIQUID LEVEL INTERFEROMETER,
Arizona Univ., Tucson. Optical Sciences Center.
S. F. Jacobs, and J. G. Small.
Applied Optics, Vol 20, No 20, p 3508-3513, October, 1981. 10 Fig, 6 Ref. OWRT A-091-ARIZ(2).

Descriptors: *Interferometry, *Water level recorders, *Water level fluctuations, *Evaporation rate, *Measuring instruments, Lasers, Water level, Water loss, Reservoirs, Design criteria, Sensors, Reservoir evaporation, Field tests, On-site tests, Ponds.

An inexpensive field instrument was designed and constructed to measure changes in water levels, appropriate to ponds and reservoirs, to an accuracy of lambda/8. A novel magnetic suspension is used to position the floating retroreflector of the laser interferometer. Direction-sensing is achieved by dual optical channels phased near quadrature by means of an absorbing beam-splitter. Field measurements were made for an open pond having a surface area of about 600 sq. m. A typical recording of evaporation over a 36-hour period is shown, including the detection of a brief period of precipitation. Using an electric fan blowing across 0.1 sq. m of water in a laboratory test, an evaporation rate in the order of one micron/minute was measured. By measuring the slopes of a 4-day recording, a record of evaporation rate was determined as a function of time of day: in addition to the expected midday peak, reproducible peaks (possibly due to morning and evening winds) were observed in the morning and evening. The laser was an inexpensive He-Ne laser which produces multiple longitudinal modes which reduce fringe contrast for large unequal paths of the interferometers arms. The instrument achieves 0.08 micron sensitivity despite moderate water turbulence, possesses directional sensing, and includes a measurement of its own temperature for thermal expansion correction. (Zielinski-MAXIMA)
W82-05929

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
J. L. Heilman, and D. G. Moore.
Remote Sensing of Environment, Vol 12, No 2, p 117-121, 1982. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Remote sensing, *Soil water, *Soil temperature, Satellite technology, Heat Capacity Mapping Mission, Mapping, Vegetation effects, Soil types, Land use.

Heat Capacity Mapping Mission (HCMM) data were analyzed to determine their suitability for estimating near-surface soil moisture in a complex agricultural landscape with several soil types and crop types. The area monitored was a 8 x 24 km section of the Big Sioux River Basin, South Dakota. The HCMM radiometric temperatures did not correlate with soil water content for the four dates analyzed (June 5, July 13, August 8, and September 4, 1978). There was a mixture of land uses and soil covers within each pixel. However, when soil surface temperatures were empirically estimated from HCMM temperatures and percentage cover of each pixel, a highly significant correlation was obtained between estimated soil temperature and near surface soil water content. (Cassar-FRC)
W82-05956

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W82-06212

TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W82-06214

PORTABLE WATER ELEVATION MEASURING GAGE,
Bureau of Reclamation, Denver, CO., Engineering and Research Center.
M. Gutierrez.
Report GR-81-14, September 1981. 31 p, 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Monitoring, *Groundwater level, *Water measurement, *Groundwater availability, *Well discharge, Salinity, Water level, Well casings, Recharge, Permeability.

One of the initial activities usually undertaken in ground-water investigations is an inventory of existing ground water availability and collection of water in wells. A portable system was developed for continuously monitoring the water elevation in wells by measuring the capacitance of an insulated wire placed in the water. The gage provides continuous readout, fast response to water elevation changes, and insensitivity to internal pressures. There is no effect on readings because of cascading water action. The gage can be initialized to read zero at various water elevations, and readings are not affected by water salinity. Results from a limited amount of testing indicate the feasibility of the measuring gage. The well under test had flaws in the well casing, and these irregularities of the well casing are shown in the test results. The detection of these irregularities led to speculation on other possible applications for the measuring gage in soil permeability testing and in detection of fractures in concrete and rock. Three methods for groundwater measurement are possible using this instrument: measurement of well discharge by water withdrawal or by disperson using air pressure in the well casing; measurement of the recharge rate after withdrawal of water; and measurement of the water elevation of normal conditions. (Moore-SRC)
W82-06396

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,
Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
G. Drufuca, and G. Macchiarella.
Atmosphere-Ocean, Vol 20, No 1, p 69-75, 1982. 4 Fig, 12 Ref.

Descriptors: *Remote sensing, *Rainfall rate, *Rainfall intensity, Precipitation intensity, Spina d'Adda, Italy, Radar, *SIRIO-SHF experiment, Model studies, Rain attenuation, Storms.

A model of rain attenuation, a bidimensional version of the snythetic storm technique, was developed and successfully tested by comparing the attenuation probability distribution from a year of measurements at 11.6 GHz and 32 degree elevation angle at the Spino d-Adda, Italy, receiving station with the rainfall rates measured at that station. Two different vertical rain profiles (rectangular and trapezoidal) reproduced the attenuation statistics, but each showed a different dependence on elevation angle, depicted on a graph for elevation angles from 5 to 45 degrees. Both models predicted lower attenuation than did the cosecant law for small elevation angles and higher attenuation for elevations above 30 degrees, particularly for the trapezoid model. (Cassar-FRC)
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. Atlas, J. Eckerman, R. Meneghini, and R. K. Moore.
Atmosphere-Ocean, Vol 20, No 1, p 50-61, 1982. 2 Fig, 21 Ref.

Descriptors: *Remote sensing, *Rainfall, *Measuring instruments, Radar, Precipitation, Storms, Microwaves, Infrared imagery, Meteorology, Radiometry, Sampling.

The visible/infrared techniques, microwave radiometry, and radar can help in obtaining useful precipitation measurements from space. No single instrument or method currently satisfies the two requirements: adequate spatial and temporal sampling of the storm and sufficient accuracy in precipitation intensity estimates. The visible/infrared instruments provide good temporal sampling and rain area depiction. Microwave obtains quantitative rainfall estimates. Radar can overcome the inadequacies of microwave radiometric measurements over land. The accuracy, dynamic size, and system implementation of several radar methods are discussed: modified altimeter (simplest, least costly, but restricted to nadir measurements), short wavelength scanning radar (can scan cross-track to provide a swath measurement), surface target attenuation radar or STAR (variations include the surface comparison and the frequency agility methods), and the adaptive pointing beam. A hybrid approach that combines the surface reference technique (STAR), the frequency agility system, the short wavelength reflecting schemes, the adaptive pointing approach, and microwave radiometry may be a starting point in development of a suitable system. (Cassar-FRC)
W82-06531

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,

Wyoming Univ., Laramie. Water Resources Research Inst.
D. L. Wichers, T. A. Wesche, L. S. Johnson, and J. A. Gore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256777, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Series Report No 83, May 1982. 48 p, 7 Fig, 2 Tab, 25 Ref. OWRT B-038-WYO(3), 14-34-0001-8130.

Descriptors: *Trout, *Aquatic habitats, *Fish migration, *Telemetry, Radiometry, Radioisotopes, Radioactivity, Radioactivity techniques, Antimony, Microenvironment, Wildlife habitats, Environment, Fish behavior, Fish populations, Remote sensing, Sensors, Ice cover.

Two techniques were devised and evaluated for locating and sampling instream brown trout microhabitat under complete ice cover conditions. Radiotelemetry (RT) using surgically-implanted transmitters (SIT) was superior to implantation of radioisotope (antimony-124) capsules for tracking under-ice movements and locating microhabitat locations. The wax-acrylic coated transmitters (15-20g) were about 2.2 inches long, and had a lifespan estimated at 6 months. Fish could be located/tracked by a receiver by walking on the ice or by flying at 500-1000 feet above the ice. The advantages of the RT method were that the use of SIT does not present a potentially hazardous situation, that locating implanted fish by RT is unimpaired by severe weather, and that signals could be sensed up to 200 m and were unaffected by water depth, ice, snow, dense undercut banks, and temperature. The major problem with SIT was battery failure. Measurements of trout movements under ice cover indicated that freezing water temperatures significantly decreased trout activity. Trout preferred to remain within focal areas as resting microhabitats, with their activity decreasing as winter conditions progress. The microhabitat preference data developed should assist recommendations of suitable winter instream flows for medium-sized trout streams which develop total ice cover during winter. (Zielinski-MAXIMA)
W82-06703

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 2D.
W82-06780

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),
Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
For primary bibliographic entry see Field 2B.
W82-06823

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),
Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
For primary bibliographic entry see Field 2D.
W82-06824

COMPARISON OF AUTOMATED SATELLITE SYSTEMS WITH CONVENTIONAL SYSTEMS FOR HYDROLOGIC DATA COLLECTION IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. M. Woodham.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $3.50 Microfiche $3.50. Open-File Report 81-1180, 1982. 23 p, 3 Fig, 5 Tab, 1 Ref.

Descriptors: *Hydrologic data collections, *Telemetry, *Remote sensing, *Data transmission, Monitoring, Sites, Satellite technology, Comparison studies, Cost analysis. *Florida, West-central Florida, GOES, Southwest Florida Water Management District.

This report provides results of reliability and cost-effective studies of the goes satellite data-collection system used to operate a small hydrologic data network in west-central Florida. The GOES system, in its present state of development, was found to be about as reliable as conventional methods of data collection. Benefits of using the GOES system include some cost and manpower reduction, improved data accuracy, near real-time data availability, and direct computer storage and analysis of data. The GOES system could allow annual manpower reductions of 19 to 23 percent with reduction in cost for some and increase in cost for other single-parameter sites, such as streamflow, rainfall, and ground-water monitoring stations. Manpower reductions of 46 percent or more appear possible for multiple-parameter sites. Implementation of expected improvements in instrumentation and data handling procedures should further reduce costs. (USGS)
W82-06951

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, P. E. O'Neill, G. C. Coleman, and T. J. Schmugge.
Agricltural Research Results ARR-NE-14, July, 1982. 18 p, 4 Fig, 6 Tab, 2 Ref.

Descriptors: *Remote sensing, *Soil water, *Hydrologic data, *Aerial photography, *Infrared imagery, Agricultural hydrology, Soil temperature, *Oklahoma.

The study sites in Oklahoma were in the Washita River Experimental Watershed, Chickasha area. Data flights were made and ground samples collected on June 24, August 14, and September 9, 1980. Soil moisture samples were collected using a gravimetric technique for depth intervals of 0-2.5, and 5-15 cm. Soil temperature samples were obtained at depths of 2.5 and 15 cm. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, L and C band radiometer, a passive microwave scanner, and four active microwave sensors (K, C, L, and P band scatterometers). Generally the soil moisture conditions were relatively wet on the date of the first flight and very dry on the last two flights. These results were ideal because the wet condition data provided verification of the sensor performance in 1978 and the dry condition data allowed the extension of the 1978 data set. The report includes soil moisture measurements, climatic observations, and the remote sensing data collected in order to evaluate aircraft remote sensing techniques. (Moore-SRC)
W82-06969

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,
Kansas State Univ. Manhattan. Dept. of Geography.
M. D. Nellis.
Remote Sensing of Environment, Vol 12, No 3, p 229-234, 1982. 4 Fig, 4 Ref.

Descriptors: *Canal seepage, *Leakage, *Remote sensing, Infrared imagery, Conveyance structures, Water conveyance, Seepage, Aircraft, *Oregon, North Unit Irrigation District, Soil water, Irrigation canals, Water loss.

Canal leakage sites were detected by a HRB Singer AN/AAS 14 optical-electronic thermal infrared scanning system, sensing in the 8-14 micron range. The apparatus was flown in an aircraft on May 21, 1979, at 2100 hours and 900 m altitude over the main North Unit Canal in central Oregon. Moist sites emitted more radiation during the evening hours and less during peak solar radiation hours than the low moisture, or nonleaking sites. Out of 39 sites showing the characteristics of leakage sites, 12 were verified as actual leakage sites by field analyses. Inspection of the canal uncovered no leakage sites not appearing on the imagery. The sites misinterpreted as leakage sites featured dense natural vegetation, farm canals, drainage ditches, small holding ponds, or natural depressed drainage areas. This interference could be reduced by taking simultaneous color photographs. This economical and practical leakage detection method could help save some of the 58,800 acre feet (or 1 acre-ft per acre of irrigated land) 0.6-7.3 m, and lengths were 12.2.-91.4 m. 75% were oblong in shape, and the remainder were irregular. (Cassar-FRC)
W82-06994

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,
Meteorological Satellite Center, Tokyo (Japan).
T. Aoki, and T. Inoue.
Remote Sensing of Environment, Vol 12, No 3, p 219-228, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Precipitable water, *Infrared imagery, *Pacific Ocean, *Geostationary Meteorological Satellite, Seasonal variation, Meteorology, Water vapor,Marine climates, Air temperature, Water temperature, Temperature, Satellite technology, Tropical regions.

Total precipitable water over the tropical oceans was determined from infrared radiometer data in the atmospheric window region using data from the Geostationary Meteorological Satellite of Japan. The information about sea surface temperature, atmospheric temperature, and atmospheric water vapor involved in the observed radiation in the atmospheric window region varied greatly with the amount of water vapor in the atmosphere and thus with the latitude. At low latitudes the atmospheric window region contained much information about water vapor and mean temperature of the lower atmosphere but very little information about the sea surface teperature. Satellite derived values agreed well with radiosonde data, within 0.53 g per sq cm rms difference. The weekly man distribution of precipitable water over the tropical section of the western Pacific Ocean was obtained for summer and winter. July 1-7, 1979, values varied from 5.0 g per sq cm north of New Guinea at latitudes 10 degrees south to 10 degrees north to 4.0 g per sq cm further from the equator. January 1-7, 1979, values showed a shift of the maximum precipitable water, 3.0 g per sq cm, to the south. Results agreed reasonably with data from other authors and measured climatological data. (Cassar-FRC)
W82-06995

7C. Evaluation, Processing and Publication

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
For primary bibliographic entry see Field 2G.
W82-05928

HYDROGEOLOGIC DATA FROM TWO WELLS AT MYAKKA HEAD, MANATEE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $3.50, Microfiche $3.50. Geological Survey Open-File Report 81-1070, 1982. 21 p, 15 Fig.

Descriptors: *On-site data collections, *Observation wells, *Well data, *Water quality, Geohydrology, Water level, Chlorides, Well logs, Hydro-

graphs, *Florida, Manatee County, Myakka Head, Southwest Florida Water Management.

Well construction data, lithologic and geophysical logs, and water-quality data are presented for a deep (1,210 feet) well drilled at myakka Head, Manatee County, Florida. A shallow well (600 feet) was drilled at the same site. The wells were drilled as part of the Southwest Florida Water Management District's Regional Observation and Monitor-Well Program. The deep well is cased to a depth of 909 feet and open from 909 to 1,210 feet. The shallow well is cased to a depth of 563 feet and open from 563 to 600 feet. Chloride concentration of water from the deep well is 17 milligrams per liter. (USGS)
W82-06129

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,
Geological Survey, Syosset, NY. Water Resources Div.
R. K. Krulikas.
Geological Survey Open-File Report 81-500 (WRI), 1981. 27 p, 2 Fig, 1 Plate, 2 Tab, 11 Ref.

Descriptors: *Areal hydrogeology, *Data collections, *Aquifer systems, *Groundwater, *Wells, Test holes, Geohydrologic units, Geology, Well data, Urbanization, Water use, Water supply, Available water, *New York, *Long Island, Suffolk County.

The population of Suffolk County, New York, an area of 922 square miles, has increased rapidly, from less than 200,000 in 1940 to about 1.3 million in 1978. Ground-water pumpage has increased from an average of 42 million gallons per day in 1950 to about 257 million gallons per day in 1978. To help supply the hydrologic information needed to anticipate and prevent shortages, this report presents hydrogeologic and well-completion data on over 700 wells and test holes. (USGS)
W82-06131

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,
Geological Survey, Bismarck, ND. Water Resources Div.
N. D. Haffield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-xxxxxx, Price codes: Axx in paper copy, A01 in microfiche. Geological Survey Open-File Report 81-1066, July 1981. 78 p, 1 Fig, 11 Ref.

Descriptors: *Hydrologic data, *Water quality, *Surface water, Streams, Sediment, Gaging stations, Sites, Sampling, Water analysis, *North Dakota.

Statistics for the streamflow and water-quality data collected at 67 stations in western North Dakota from October 1977 through September 1980 are presented in a format that will make the data more useful to those who are making water-resources planning and development decisions. (USGS)
W82-06133

GROUND-WATER DATA FOR THE BERYL-ENTERPRISE AREA, ESCALANTE DESERT, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Mower.
Geological Survey Open-File Report 81-340, 1981. 64 p, 1 Fig, 1 Plate, 6 Tab.

Descriptors: *Data collections, *Groundwater, *Wells, *Water level, *Water quality, Chemical analysis, Water yield, Observation wells, Drillers logs, Well data, *Utah, Escalante Desert, Beryl-Enterprise area.

This report contains a compilation of selected ground-water data for the Beryl-Enterprise area, Iron and Washington Counties, Utah. The records of the wells include such information as driller's logs, yield, drawdown, use, and temperature of the well water. There are also records of water levels in selected wells for the period 1973-79, chemical analyses of ground water, records of selected springs, and a tabulation of ground-water withdrawals for 1937-78. (USGS)
W82-06134

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1051 (WRI), 1980. 1 Sheet, 25 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Groundwater, Natural recharge, Water level, Observation wells, Water level fluctuations, Geohydrology, Hydrographs, *Mississippi, Sparta aquifer system, Sparta Sand.

This potentiometric map of the Sparta aquifer system is the tenth in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Sparta, the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer into streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson, Yazoo City, Cleveland, Clarksdale, and Memphis areas. Historically, water levels in or near the outcrop of the Sparta have shown little or no long-term changes, but during the past 20 years, in much of the confined part of the aquifer, water levels have declined from 1 to 3 feet per year. (USGS)
W82-06135

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWER-PLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-06137

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Geological Survey Open-File Report 81-1123 (WRI), 1981. 1 Sheet, 8 Ref.

Descriptors: *Maps, *Water level, *Groundwater, *Alluvial aquifer, Aquifer characteristics, Deltas, Wells, Precipitation, Water level fluctuations, Pumping, Irrigation, Geohydrology, Hydrographs, *Mississippi, Mississippi River valley alluvial aquifer.

Water levels were measured in 454 wells in the alluvial sediments in northwestern Mississippi during the period April 13-24, 1981. Ground-water levels are higher after winter and spring rains and lower after heavy agricultural and industrial pumping. Locally, water levels fluctuate as rivers and streams fluctuate. Because of the drought conditions in April 1981, most water wells had risen several feet. In some areas, however, water levels had not recovered from the relatively low levels measured in September 1980. (USGS)
W82-06138

SELECTED BIOLOGICAL CHARACTERISTICS OF STREAMS IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Naten, and R. H. Fuller.
Geological Survey Open-File Report 81-644 (WRI), 1981. 38 p, 26 Fig, 4 Tab, 12 Ref.

Descriptors: *Data collections, *Biological samples, *Water quality, Oil shale, Environmental effects, Bacteria, Benthic fauna, Ecological distribution, *Utah, *Colorado, Uinta Basin.

Biological sampling was carried out during 1976-78 in five streams in the southeastern Uinta Basin, Utah and Colorado, in order to provide baseline water-quality data for an area of potential oil-shale development. The biological activity in the streams sampled generally is limited by physical factors more so than by chemical constituents and plant nutrients. Characteristics of streamflow, such as high turbidity, fluctuating water levels, and moderate to high salinity, limit production of flora and fauna biomass. Samples were collected for the determination of bacterial and periphyton concentrations and benthic-invertebrate communities. Bacterial concentrations were generally small, with some fecal contamination, primarily from livestock and wildlife. Members of the order Chlorophyta (green algae) were the major periphytic algae present in three of the streams sampled. Bitter Creek was dominated by members of the order Cyanophyta (blue-green algae), and pennate diatoms were the predominant algae in Willow Creek. The benthic-invertebrate communities generally reflect a nonpolluted environment. Shannon-Weiner diversity indices ranged from 1.14 to 3.08. (USGS)
W82-06140

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06142

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190364, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OR-80-2, December 1981. 491 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Western Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-state partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06143

SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202045, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CO-80-3, 1981. 452 p, 4 Fig, 5 Tab, 42 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Dolores River basin, Green River basins, San Juan River basin.

Water-resources data for Colorado for the 1980 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage patial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W82-06144

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
O. Mintzer, and F. Askari.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243668, Price codes: A04 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, Report No 712508, October 1980. 53 p, 14 Fig, 13 Tab, 32 Ref, 7 Append. OWRT A-063-OHIO-(1).

Descriptors: *Remote sensing, *Mathematical models, *Regression analysis, *Spectral analysis, *Runoff coefficients, Aerial photography, Satellite technology, Sensors, Telemetry, Infrared imagery, Watershed management, Runoff, Mathematical studies, Data interpretation, Experimental data, Watersheds, Model studies, *Ohio, Mill Creek.

Research was carried out to derive runoff coefficients for watersheds of Mill Creek in Coshocton County, Ohio, from LANDSAT multispectral data by including the more detailed (level II) surface conditions and soil types along with land cover (level I) types in the analysis techniques. Regression models were developed from treating the runoff coefficient of each sample site as the dependent variable, and the mean radiance measurements in the four LANDSAT channels as the independent variables. The models were then extended over the area, and the classification results consisted of digital color-coded maps illustrating spatial variability of runoff potential for the surface. The computer-derived patterns were confirmed with known features within the area, and individual test fields and watersheds were selected for verification of the model results. The model-derived runoff coefficients compared favorably with those obtained from ground truth. It was concluded that, for the sampled sites of the given land cover conditions and soil type, the multispectral data analysis technique described provided reasonable values of runoff coefficients for the watersheds tested. (Zielinski-MAXIMA)
W82-06151

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
C. H. Whitlock, C. Y. Kue, and S. R. LeCroy.
Remote Sensing of Environment, Vol 12, No 2, p 151-168, 1982. 6 Fig. 5 Tab, 19 Ref.

Descriptors: *Remote sensing, *Regression analysis, *Pollutant identification, Radiance, Network design, Satellite technology, Errors, *Sediments. The limitations, requirements, and precision of linear multiple regression techniques for quantifying marine environmental parameters such as sediments and pollutants were evaluated. Radiance was the independent variable. Both environmental and optical physics conditions were defined for which an exact solution to the signal response equation is of the same form as the multiple regression equation. One problem with using this regression technique is that the independent variables. (Upwelled radiaces) contained errors which were often correlated with each other. This situation required a large number of statistical parameters when performing the regression analysis. Examination of field experiments showed that the magnitude of the data noise required data smoothing before Daniel and Wood's criteria could be satisfied for the least-square multiple regression process. To minimize data smoothing requirements and associated physical errors, ground truth locations whould be carefully chosen. Specific suggestions for environmental and ground truth conditions are given. (Cassar-FRC)
W82-06233

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,
Technicon Instruments Co. Ltd. (England).
For primary bibliographic entry see Field 5F.
W82-06259

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 4A.
W82-06300

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. R. Chirlin, and E. F. Wood.
Water Resources Research, Vol 18, No 2, p 432-438, April, 1982. 1 Fig, 17 Ref.

Descriptors: *Spatial distribution, *Estimating equations, *Statistical analysis, Model studies, *Probability distributions, Stationary process, Hydrologic data, Mathematical studies, *Kriging, *State estimation.

Universal kriging is one method of interpolating sampled random spatial processes which has applications in hydrology. The interpolation task is complicated by process noise and data measurement error. Kriging is a technique which refers to a family of stochastic process models plus associated parameter estimation procedures. It is based on a theory of 'differencing' of n-dimensional spatial processes and is well developed for the delineation of mineral deposits. Universal kriging interpolates a discrete stationary spatial process obtained by polynomial filtering through spatial differencing of the original nonstationary process. In this paper, the universal kriging axioms, calculation of some statistics of the kriging system variables, definition and solution of the state space version of the kriging problem, and an example are presented. (Titus-FRC)
W82-06323

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. R. Philipson, K. Kozai, and E. L. Mills.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256637, Price codes: A03 in paper copy, A01 in microfiche. Report, December, 1981. 29 p, 8 Fig, 4 Tab, 49 Ref, 1 Append. OWRT A-091-NY(1). 14-34-0001-1134.

Descriptors: *Water quality, *Eutrophic lakes, *Remote sensing, *Satellite technology, *Regression analysis, Evaluation, Sensors, Telemetry, Mathematical models, Computer models, Mathematical studies, Model studies, Water quality control, Lakes, Chlorophyll A, Density stratification, Air temperature, Wind, Lake breezes.

A methodology development was undertaken for use in selecting optimum sampling locations for water quality assessment in a large eutrophic New York State lake (Oneida Lake). The methodology approach was based on the premises that Landsat satellite image densities can be modeled, and that homogeneous water quality areas could be thereby predicted. Patterns of Lake density on 24 Landsat band-5 images (0.6-0.7 microns) were traced from a density-slicer screen, following standardization of the color assignments with dark- and a light-toned feature. The Lake was griddled into 161 cells (1.25 km by 1.25 km each), and density levels from each image were encoded for each cell. Cell density levels were used as the dependent variable in correlations and multiple regressions with degree days, and resultant wind speed and direction. Further, equation-predicted density levels in selected cells were correlated with measured values of chlorophyll-A, chlorophyll-a plus pheophytin, and Secchi disk transparency. It was found that the use of degree days and wind in evaluating water quality represents a promising and improved approach. While reliability of the regression equations was too low to develop an effective lake sampling strategy, results suggest further study appears justified. (Zielinski-MAXIMA)
W82-06370

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,
Natal Univ., Pietermaritzburg (South Africa).
For primary bibliographic entry see Field 2E.
W82-06386

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W82-06529

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),
Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131-S, Background Data Supplement, 1981. 121 p, Tab.

Descriptors: *Canada, *Eutrophication, Nutrient reduction, Phosphorus, Nitrogen, Chlorophyll, Hypolimetic oxygen rate, Loadings, Data, Lakes, Basins, Graphs, *Data collections, *Pollutant identification.

This background data supplement contains information sheets listing the most pertinent background information for the lakes and basins discussed in the main report; The OECD Cooperative Programme on Eutrophication Canadian Contribution, (Scientific Series No. 131). (WATDOC)
W82-06567

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,
Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
For primary bibliographic entry see Field 2E.
W82-06568

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06586

THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,
Department of the Environment, Reading (England). Water Data Unit,
R. V. Moore, and D. W. C. Rodda.
Water Science and Technology, Vol 13, No 11/12, p 707-714, 1981. 2 Fig, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Data storage and retrieval, Computers, Data management, Data collections, *United Kingdom, Water quality data, Hydrologic data collections.

Ten regional authorities in England and Wales have responsibility for all aspects of the water cycle, including monitoring of water quality. These authorities collect data for their own water management needs, for assessing the effectiveness of water pollution legislation, and for determining the rate of improvement or deterioration of water resources. The need for similar types of information and for information which can be compared among the regions has led to the development of the Water Archive System, which provides a cost-effective solution to the organization and control of data for the authorities. The Water Archive System manages water quality data; hydrological, biological, and meteorological data; and data on water supply and wastewater disposal. The objectives and applications of this national computer-based system are described. The computer system is simple in concept and use, but capable of handling a wide range of data. A high level of user participation in project management has been encouraged in order to promote commitment to the project. A System for achieving national agreement with respect to data definitions has helped to promote data comparability. The Water Archive System is currently used by seven of the regional water authorities, as well as by the British Department of the Environment and by the Ministry of Agriculture, Fisheries, and Food. (Carroll-FRC)
W82-06591

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,
For primary bibliographic entry see Field 2A.
W82-06613

WATER RESOURCES DATA FOR TENNESSEE, WATER YEAR 1980.
Geological Survey, Nashville, TN. Water Resources Div.
Geological Survey Water-Date Report TN-80-1, 1981. 513 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water levels, Data collections, Sites, *Tennessee.

Water resources data for the 1980 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 108 gaging stations, stage only records for one lake gaging station, elevation and contents for 27 lakes and reservoirs, water quality for 82 stations and 21 wells, and water levels for 26 observation wells. Also included are 127 crest-stage partial-record stations, 73 low-flow partial-record stations, and 80 coal-hydrology partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (USGS)
W82-06670

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. P. Thomas, and A. Dunne.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $31.50, Microfiche $3.50. Geological Survey Open-File Report 81-1071, August 1981. 230 p, 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Floods, *Basins, *Streamflow, *Flood data, Surface water, Flood peak, Flow characteristics, Flood frequency, Flood recurrence interval, Gaging stations, Monitoring, *New Mexico, Log Pearson type III analysis.

Selected basin characteristics, flood characteristics, flood statistics and peak flows are summarized for 277 unregulated basins in New Mexico and adjacent areas of conterminous States. Station descriptions are included in the peak flow listing; a State map shows areal location. (USGS)
W82-06671

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,
Geological Survey, Austin, TX. Water Resources Div.
R. Perez.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $11.75, Microfiche $3.50. Geological Survey Open-File Report 81-922, August, 1981. 91 p, 1 Fig, 5 Tab, 5 Ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, *Storm runoff, *Urban runoff, *Hydrologic data, Small watersheds, Streamflow, Flow rates, Flood peak, Flood profiles, Watershed Management, *Texas, San Antonio.

This report contains rainfall, runoff, and water-quality data collected during the 1978 water year for the San Antonio metropolitan area. The information will be useful in determining the effects of various stages of ubanization on flood discharge and runoff and in determining chemical constituents in surface-water runoff from floods of various magnitudes during all seasons of the year from areas with different types of urban development. Detailed rainfall-runoff computations are presented for several storm periods during the 1978 water years. (USGS)
W82-06672

WATER-RESOURCES INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN ARKANSAS--FISCAL YEAR 1981.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $6.50, Microfiche $3.50. Geological Survey Open-File Report 81-1003, 1981. 44 p, 20 Fig. (Gurley, M. O., Compiler).

Descriptors: *Data collections, *Groundwater, *Water quality, *Surface water, Gaging stations, Sites, Streamflow, Flow characteristics, Sediments, Dye releases, Sampling, Water level, Wells, Water use, *Arkansas.

During fiscal year 1981 there were 20 water-resources investigations in progress by the Arkansas District of the U. S. Geological Survey's Water Resources Division. Investigations that mainly involved data collection included surface-water gaging, water-level measuring, water-quality sampling, sediment sampling, and water-use inventorying. Interpretive studies included three that were principally of ground-water resources, four that were of surface-water flow charateristics, four that were of surface-water quality characteristics, and three that were interdisciplinary. (USGS)
W82-06673

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1981--VOLUME 1. CENTRAL AND NORTHERN LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Geological Survey Water-Date Report LA-81-1, 1981. 424 p, 10 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, Central and Northern Louisiana.

Water resources data for the 1981 water year for Lousiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage of 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data system operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-06674

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1053 (WRI), 1981. 1 Sheet, 22 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Goundwater, Natural recharge, Water level, Observation wells, Water level fluctutations, Geohydrology, Hydrographs, *Mississippi, Cockfield formation, Cockfield aquifer.

This potentiometric map of the Cockfield aquifer is the eleventh in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Cockfield quifer the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer by streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson and Greenville areas. Historically, water levels in or near the outcrop of the Cockfield aquifer have shown little or no long-term changes, but in much of the confined part of the aquifer during the past 20 years, water levels have declined from 1 to 2 feet per year. (USGS)
W82-06676

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-06681

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,
Geological Survey, Tallahassee, FL.. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
J. A. Leenheer, and J. C. Bagby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195280, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 82-15, March 1982. 39 p, 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Organic compounds, *Groundwater, *Water quality, *Path of pollutants, Observation wells, Monitoring, Sampling, Pesticides, Radioactive waste disposal, Aquifers, Groundwater movement, Geochemistry, *Idaho, Snake River Plain aquifer, Idaho National Engineering Laboratory.

In August 1980, the U.S. Geological Survey started a reconnaissance survey of organic solutes in drinking water sources, ground-water monitoring wells, perched water table monitoring wells, and in select waste streams at the Idaho National Engineering Laboratory. The survey was to be a two-phase program. In the first phase, 77 wells and 4 potential point sources were sampled for dissolved organic carbon (DOC). Four wells and several potential point sources of insecticides and herbicides were sampled for insecticides and herbicides. Fourteen wells and four potential organic sources were sampled for volatile and semivolatile organic compounds. The results of the DOC analyses indicate no high level organic contamination of ground water. The only detectable insecticide or herbicide was a DDT concentration of 10 parts per trillion (0.01 microgram per liter) in one observation well. The volatile and semivolatile analyses do not indicate the presence of hazardous organic contaminants in significant amounts (>10 micrograms per liter) in the samples taken. Due to the lack of any significant organic ground-water contamination in this reconnaissance survey, the second phase of the study, which was to follow up the first phase by additional sampling of any contaminated wells, was cancelled. (USGS)
W82-06688

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W82-06690

HYDROGEOTHERMAL MAPPING OF THE ACTIVE WATER-EXCHANGE ZONE IN THE USSR,
All Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. M. Frolov.
Water Resources, Vol 8, No 3, p 319-328, May/June, 1981. 2 Fig, 3 Tab, 11 Ref. Translated from Vodnye Resursy, No 3, p 154-166, May/June, 1981.

Descriptors: *Maps, *Geohydrology, *Heat flow, Groundwater, *USSR, Temperature gradient, Geologic mapping, *Geothermal studies, Heat transfer.

The existing USSR hydrogeothermal maps of the active water exchange zone are described and analyzed. The first hydrogeothermal map of the USSR was prepared in 1962. Geothermal maps, compiled without consideration of hydrogeological features, had been prepared before this date. The 'Hydrogeothermal Atlas of the USSR,' published in 1975-77, included maps of geoisotherms of the neutral layer (average long-term groundwater temperature), geoisotherms of depths of 125 and 250 m, and other related maps. Thermometric investigations showed that the mean differences between regional geotemperature field and actual temperature measurements were 0.2 C at 25 m depth and -3.0 C at 125 m depth. Conclusions reached on the basis of these maps were that low heat fluxes are present for depths of 250 m in the northern regions of the country and that the geotemperature and thermal fields to at least 250 m were formed under exogenic rather than endogenic influences. The neutral Layer iiin the USSR is mainly within 15-25 m in regions of clays, peats, and loams. In central regions of the European USSR the thickness of the layer of annual variable temperature exceeds 35 m because of the predominance of sands and loam sands and the confinement of the regions to the zone of surplus water. (Cassar-FRC)
W82-06782

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,
Novosibirsk State Univ. (USSR).
M. T. Gladyshev.

Recent work (1974-80) on numerical methods for calculating flows in hydraulic engineering, as developed at Novosibirsk University, is reviewed. The methods are based on numerical solutions of St. Venant equations for one-dimensional unsteady flows. A General Statement of the problem of two-dimensional unsteady flows was formulated, allowing isolation of the breakthrough wave and moving boundary along a dry bottom. Three types of problems were solved by finite difference methods: smooth flows in a channel with vertical walls, discontinuous flows in a channel with vertical walls, and propagation of a breakthrough wave along a dry and wet bottom with isolation of the leading edge. Two-dimensional flows were calculated for the problem of dam failure in the case of a dry and wet bottom. Many experiments were carried out for the case of moving boundaries of liquid layers. For example, the method of moving meshes was used in problems of the inflow of a heavy liquid into a channel with a light and also on failure of a dam with a two-layer reservoir. (Cassar-FRC)
W82-06784

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-1, 1981. 225 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Apalachicola River basin, Choctawatchee River basin, Blackwater River basin, Escambia River basin, Perdido River basin, Alabama River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs, and water levels in wells. This report contains discharge records for 49 gaging stations, stage only for 15 gaging stations, stage and contents for 8 lakes and reservoirs, water quality for 34 gaging stations, and water levels for 11 observation wells. Also included are 21 low-flow partial-record stations, 16 crest-stage partial-record stations, 7 flood hydrograph partial-record stations, and 8 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGUOULA, AND TENNESSEE RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-2, 1981. 483 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Stream-flow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Tombigbee River basin, Mobile River basin, Dog River basin, Pascagoula River basin, Tennessee River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 48 gaging stations, stage only for 7 gaging stations, stage and contents for 4 lakes and reservoirs, water quality for 46 gaging stations, and water levels for 46 observation wells. Also included are 3 low-flow partial-record stations, 4 crest-stage partial-record stations, 4 flood hydrograph partial-record stations, and 101 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systeatic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2A, 1981. 564 p, 14 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous or daily discharge for 82 streams, periodic discharge for 1 stream, peak discharge for 2 streams, continuous or daily stage for 21 streams, periodic stage for 37 streams, continuous elevations for 15 lakes, periodic elevations for 4 lakes, and quality of water for 136 surface-water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State, and Federal agencies in Florida. (USGS)
W82-06955

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2B, 1981. 322 p, 18 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, Water analysis, Water temperature, Chemical analysis, Wells, Water level, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous ground water levels for 178 wells, periodic ground water levels for 178 wells, miscellaneous water level measurements for 539 wells, and quality of water for 282 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-06956

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190356, Price codes: A12 in Paper copy, A01 in Micro-

fiche. Water-Data Report OR-80-1, 1981. 244 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Eastern Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and resrvoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06957

8. ENGINEERING WORKS

8A. Structures

DEVON FLOODS AND THE WATERWAYS OF BRIDGES,
A. B. George.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 125-134, March, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Bridges, *Channel scour, *Flood damage, Flood channels, Flood control, Flood flow, Flood frequency, Devon, Rivers, Design criteria, Highways, Annual floods, Historic floods, Channel improvement.

Floods in Devon in 1952, 1960, 1968, and 1979 caused widespread bridge destruction. Damage in the region was caused by the intensive energy of the flowing water in the steep terrain and by inundation. Return peiods of the floods varied from 6 to 600 years and reatios of major flood to mean annual flood were up to 3.31. It is suggested that mean annual flood be calculated using an equation with more independent variables (area, soil type, and one day net rainfall for a 5 -year return period) than the commonly used formula, which uses area as its only dependent variable. Bridges should be designed to withstand a 1000-year flood at a location immediately downstream of a community, a 150-year flood for bridges carrying motorways and trunk roads, a 30-150-year flood for bridges carrying less important roads, and a 5-year flood for submersible bridges in very rural areas. All bridges should pass the mean annual flood at or below bank-full level. (Cassar-FRC)
W82-05948

PLANNING SRI LANKA'S VICTORIA SCHEME,
Preece, Cardew and Rider, Brighton (England).
J. C. Bennett, and T. G. Carpenter.
International Water Power and Dam Construction, Vol 34, No 5, p 67-73, May, 1982. 8 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Dam design, Irrigation, Victoria Dam, *Sri Lanka, Mahaweli Ganga, Reservoirs, Planning, Arch dams.

The planning process for Sri Lanka's Victoria multipurpose dam scheme on the Mahaweli Ganga is described. The proposed project, scheduled for completion in 1984-85, will provide power and irrigation water for the region until 1990. At that time the installed capacity will be doubled to about 420 MW to handle peak demands. A double-curvative arch dam of 118 m maximum height and normal top water level of 438 m was found suitable for the site at Victoria Falls near Kandy. (Cassar-FRC)
W82-05979

COLD REGIONS ENGINEERING IN NORWAY,
Norwegian Road Research Lab., Oslo.
K. Flaate.
Civil Engineering (New York), Vol 52, No 4, p 68-69, April, 1982. 5 Fig.

Descriptors: *Ice, *Road construction, Frost heaving, Cold regions, Roadbanks, Highways, Paving, Design criteria, Construction, Tunnels, Freezing, Ice formation, *Norway.

In much of Norway and other cold regions, damage from frost-heaving, icing of roads, freezing of water pipes, and reduced bearing capacity of subsoil are common. In the last two decades Norwegian engineers have concentrated their efforts on research and practical solutions to these problems, with excellent results. Cracking of asphalt paving can be reduced by reinforcement with steel mesh or a mesh of other suitable materials. Monitoring is performed throughout the year to evaluate the bearing capacity of the roads. If the freezing index exceeds a given level, it is necessary to insulate the drainage system around a tunnel. Since there is not much loss of heat due to radiation inside a tunnel, the icing problem is not as severe as in the open, and a rather thin pavement above the insulation will be sufficient. (Baker-FRC)
W82-06000

DESIGN TECHNIQUE DEVELOPMENT FOR DAMS IN SOUTH AFRICA,
Department of Environmental Affairs (South Africa).
W. C. S. Legge.
Aqua, No 2, p 378-380, 1982.

Descriptors: *Design criteria, *Dam design, *Dam construction, Concrete dams, Earth dams, Rockfill dams, *Reservoir construction, *South Africa, Dams, Dam foundations, Dam stability, Rock mechanics, Soil mechanics, Tensile stress, Reservoirs, Construction, Technology, Engineering.

Over the past 80 years, the construction of dams and reservoirs in South Africa has been influenced by developments in engineering technology. In the 1930's, the science of soil mechanics was applied to dam construction, while the instrumentation of early concrete arch dams was confined to deflection surveys. After World War II, the design of arch dams was improved from the trial load method through wire models and deflection models to the analytical methods of finite element type presently in use. Improvements in techniques for placing mass concrete aided in the construction of several large dams, while a better understanding of the elasticity of earthen embankments was developed. The ability to move large volumes of earth and rockfill has allowed the construction of earth and rockfill embankments where the construction of concrete dams is not feasible. The latest design technologies allow engineers to test dam safety features as well as the tensile forces on the upstream face of arch dams. (Geiger-FRC)
W82-06011

SOME GEOTECHNICAL ASPECTS OF THE CONSTRUCTION OF THE 'SAFETY RESERVOIR BROECHEM',
Antwerp Water Works (Belgium). Dept. of Civil Engineering.
H. Crommelinck, and J. Dirickx.
Aqua, No 2, p 385-396, 1982. 19 Fig.

Descriptors: *Reservoir storage, *Reservoir construction, *Earth dams, *Storage reservoirs, *Design criteria, Construction, Reservoirs, Reservoir linings, Hydraulic-fill dams, Reservoir siting, Site selection, Storage, Drinking water, Water supply, Water supply development, Earthworks.

The Antwerp Water Works of Belgium has decided to erect a security reservoir to ensure that the surface waters of the river Meuse will be able to supply drinking water to about 1 million people. A construction site along the adduction area of the Albertcanal and in the vicinity of the Oelegem treatment plant was chosen for the Brochem Reservoir, which will support a useful capacity of 4.5 million cu m raw water. Water will be transported by gravity to the nearby treatment works. After pilot studies on compaction techniques, the earth dam was compacted by vibroflotation and squeezing of mud with compacted gravel. Sounding tests showed adequate compaction by these methods of the clayey deposit and sandy hydraulic fill to be used as the foundation of the 10 m high reservoir. After extensive calculations of membrane requirements, a membrane composed of mainly nylon-reinforced bitumen with a polyethylene sheet was chosen to line the slopes of the reservoir. The bottom of the reservoir was waterproofed by clayey particles from the raw water of the Albertcanal. A permanent drain was constructed to handle accidental seepage through the bottom of the reservoir due to cracks of fissures in the waterproof membrane. The reservoir may be used in 1982 after the electro-mechanical installation is completed. (Geiger-FRC)
W82-06012

THE BIESBOSCH WATER STORAGE SCHEME,
Biesbosch Water Storage Corp. (Netherlands).
P. L. Knoppert, and E. G. H. Vreedenburgh.
Aqua, No 2, p 381-384, 1982. 3 Fig.

Descriptors: *Reservoir construction, *Reservoir design, *Reservoir storage, Safe yield, Multipurpose reservoirs, Water supply development, Reservoirs, Water quality control, Reservoir linings, Reservoir sites, Storage reservoirs, Multireservoir networks, Dikes, Earthworks, Construction.

The western and northern parts of the Netherlands rely mainly on fresh surface water from the Rhine and Meuse Rivers for their drinking water supplies. Problems with salt water intake into water treatment plants in 1963 caused the local governments to look to the river Maas to supply a higher quality drinking water source for the Rotterdam area. The construction of reservoirs in the Biesbosch, a deltaic area south of Rotterdam, was necessary to store water from the Maas to bridge periods of low flow and improve water quality. Calculations to determine the safe yield, required volume for bridging functions, and required volume for improved water quality were made for the three reservoirs of the Biesbosch water storage scheme. A second planning phase will provide for an extension with a fourth reservoir. Reservoirs were constructed partly by raising the water level above the surrounding area by dikes and partly by excavating the ground between the dikes. Dikes were lined with a membrane of nylon fabric placed on sand-tight fabric overlined with stone. The completed reservoir area was landscaped to maximize the recreational functions of the area while minimizing interference with the natural deltaic creek system and existing agricultural polders as much as possible. The safe yield storage of the first three reservoirs amounts to 250 million cu m/yr, a figure which will increase to 500 million cu m/yr when the fourth reservoir is built to meet increased water quality and quantity demands. (Geiger-FRC)
W82-06014

BLOOMINGTON LAKE - POTOMAC RIVER WATER RESOURCES PROJECT,
Army Engineer District, Baltimore, MD.
J. W. Peck.
Civil Engineering (New York), Vol 52, No 6, p 47-49, June, 1982.

Descriptors: *Dams, *Construction, *Design criteria, Construction materials, Water quality, Flood control, Bloomington Lake, *Bloomington Dam, *Potomac River, Maryland, *Earth dams, Cofferdams, Rockfill dams, Rolled-earth dams, Dikes, Earthworks.

The Bloomington Dam is located about a 4 hr drive west of Baltimore on the Potomac River.

The complex planning of the project took almost 19 years, and it consists of a main embankment, dike, spillway, intake tower, tunnel, and other structures. In order to construct the dam, relocation of a railroad, highways, and utilities was required. Twenty construction contracts were awarded, for a total construction cost of $174,300,000. The dam embankment is a rolled earth and rockfill structure founded on bedrock throughout. It has a maximum height of 296 feet above streambed, a crest length of 2,130 feet, and is comprised of a total volume of 10.5 million cubic yards of earth and rock fill. In a saddle a short distance from the left abutment of the dam is a dike embankment which is a rolled earth and rockfill structure having a height of 89 feet, a crest length of 880 feet and a total volume of over 1 million cubic yards. One of the major concerns with embankment construction is the contact surface between the embankment and foundation surface. Extensive use was made of mini-cam photogrpahy equipment to constantly record various features of the work as it progressed. A small dike was constructed to divert the river into the completed outlet tunnel so the cofferdam and foundation preparation work could be done. Flood control will provide major benefits to the downstream communities some 25 miles below the dam. Water quality accounts for 51% of the benefits of this project. Value engineering was used effectively throughout the construction of the project, with over $3 million in savings realized. (Baker-RC)
W82-06183

OLMOS DAM MODIFICATION.
Civil Engineering (New York), Vol 52, No 6, p 54-55, June, 1982. 2 Fig.

Descriptors: *Dams *Flood control, Construction, Olmos Dam, Design criteria, Spillways, *Texas, San Antonio River.

Olmos Dam is located on Olmos Creek, which is a tributary of the San Antonio River northeast of the central business district of San Antonio, Texas. In 1973 a study disclosed that flood routings produced by severe storms over the drainage basin would overtop the dam by varying amounts, and the structure would be overstressed beyond the permissible limits of current design. The reduced factors of safety could have resulted in failure. Olmos dam is a dry reservoir dam, holding water only as a result of heavy rains flooding the area. The safety study suggested several modifications, including provisions of an ogee spillway section with flip bucket at the central portion of the dam structure with crest at elevation 728, 1287 feet long, capable of passing the probable maximum flood. The Olmos Drive roadway across the top of the dam was to be removed. A new gate operating room was to be built atop the non-overflow section. Increased stability of the spillway portion was achieved by addition of mass concrete. Dam stability was increased in the non-overflow portions by vertical prestressing of the dam structure. Modifications to retain the 200 year flooding flow with zero outflow for some hours for staged release in consideration of potential impact on the downtown area of a flood were made. The relocation and reconstruction within the dam structure of major telephone trunk line were performed and an inspection gallery was provided. One problem during construction was excessive groundwater in the limestone stratum at the contact plane for the dam. (Baker-FRC)
W82-06186

SAFETY ASPECTS IN THE DESIGN AND INSPECTION OF DAMS,
COBA-CONSULPRESA, Lisbon (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 34, No 5, p 45-47, May, 1982. 8 Ref.

Descriptors: *Dam failure, *Design criteria, *Safety, Gravity dams, Buttress dams, Arch dams, Earth dams, Rockfill dams, Spillways, Outlets, Errors, Inslpection, Dam construction, Dam design, Dam foundations, Dam stability.

A listing of scenarios for rupture and hazard scenarios (serious incidents) can help in design of new dams, in judging the safety and reliability of old dams, and in avoiding most human errors. Dam failures depend on height (low dams fail more often than high dams), type of dam (arch dams are are most stable), materials (earth dams are most vulnerable), location, age (very new and very old dams are most likely to fail), and quality of design. Overtopping accounts for a third of disasters. Other causes are piping, abnormal uplift, foundation defects and wearness, earthquakes, weak materials, erroneous design, and poor construction. A listing of hazard scenarios is given for all types of dams. This includes sudden filling of a lake and overtopping of a dam, closure of a valley by mountain movement, piping, ground differential motion at the foundation, inadequate design, faulty construction, and subsidence of the foundation from earthquakes or subterranean water drainage. Additional hazard scenarios are given for specific types of dams: gravity, buttress, arch, multiple arch, earth, rockfill, spillways, and outlets. (Cassar-FRC)
W82-06203

THE ITAIPU HOLLOW GRAVITY DAM,
Promon Engenharia, Sao Paulo (Brazil).
D. M. Caric, L. P. Eigenheer, J. Uriarte, A. Szpilman, and A. Gallico.
International Water Power and Dam Construction, Vol 34, No 5, p 30-44, May, 1982. 19 Fig, 5 Tab, 14 Ref.

Descriptors: *Hydroelectric plants, *Dam design, Itaipu Dam, Brazil, Paraguay, *Parana River, Hollow dams, *Gravity dams, Dam construction, Concrete dams, Hydraulic structures, Dam foundations, Grouting, Drainage, Stress analysis, Dam stability, *Hollow construction dams.

The civil works at the Itaipu hollow gravity dam on the Parana River, Brazil-Paraguay, are scheduled for completion by the end of 1982. The structure is 612 m long and consists of 18 blocks each 34 m wide. The blocks range from 100 to 196 m high, making Itaipu the highest hollow gravity dam in the world. The 1260 MW final capacity and annual generation of 75,000 GWh will make this the largest power station in the world when it is completed in 1988. The hollow construction requires 25% less concrete than solid construction, has better stability against overtopping, better head dissipation, greater construction flexibility, less hydraulic uplift, more effective drainage, and 12% lower costs. However, the concrete for a hollow dam requires a higher proportion of cement, more framework, more complex concrete shapes, a complex benched excavation on sloping abutments, some steel reinforcement, and higher engineering costs. Nevertheless, the the Itaipu dam the hollow construction gave a savings of 1.3 million cu m of concrete and 6 months of construction time. Detailed descriptions and drawings are given for the hollow block shape, longitudinal and transverse contraction joints, and concrete temperature control. The foundation's geology, configuration, treatment, grouting, and drainage are described. Stress and stability tests are also discussed. (Cassar-FRC)
W82-06205

INVESTIGATION OF THE OVERFLOW SPILLWAY OF THE VELISHCHAI RESERVOIR,
Z. A. Musaev.
Hydrotechnical Construction, Vol 15, No 7, p 414-417, 1981. 2 Fig, 2 Tab, 2 Ref. Translated From Gidroteknicheskoe Stroitel'stvo, No 7, p 25-27, July, 1981.

Descriptors: *Spillways, *Reservoirs, *Intake gates, *Design criteria, *Dam construction, *Model studies, *Wave action, Dams, Reservoir storage, Mathematical studies, Mathematical models, Aeration.

The proposed design of the overflow spillway of the Velischai reservoir which was constructed to irrigate the lands of the Masally region of the Azerbaidzhan SSR was investigated. The height of the side walls was determined without considering the occurrence of aeration of the flow and rolling waves. Experimental data on aeration and wave formation on the conveyance flume was obtained for a parapet design with one-way overflow of water. Studies on two-way overflow revealed an improved hydraulic regime of flow both in the intake and in the horizontal section of the spillway model. By arranging the intake flume angles at 80 degrees to the axis of the dam, a two way intake in the given layout of the hydrodevelopment was achieved. With a specific parapet design, the useful storage of the reservoir was increased by raising the elevation of the spillway sill of the intake part without increasing the amount of works on the dam. This produces additional net income during the payback period, resulting in greater annual savings. (Geiger-FRC)
W82-06220

REGIONAL DETENTION BASINS FOR STORMWATER CONTROL,
Whiteley-Jacobsen and Associates, Portland, OR.
G. E. DiLoreto.
Public Works, Vol 113, No 5, p 61-62, May, 1982. 1 Fig.

Descriptors: *Storm water, *Detention reservoirs, *Drainage systems, Storm runoff, St. Helens, *Oregon, Design criteria, Runoff, Urban Runoff, Controlled drainage.

Regional detention basins were chosen as the best storm water control option at St. Helens, Oregon, since the topsoil overlying impermeable basalt is only 1-2 feet deep, precluding economical construction of drainage pipes and open channels. Maintenance costs associated with a few large regional basins are much less than costs of hundreds of small detention ponds. Design considerations for regional detention basins are: sediment traps, consideration of soil characteristics and groundwater table, a bank slope of 3:1 horizontal and vertical, low flow bypass channels, emergency spillways for events exceeding the design storm, maximum depth of 4 ft with 1 ft of freeboard, a 1% bottom slope toward the low flow bypass channel, and stabilized banks. (Cassar-FRC)
W82-06225

SAFETY OF DAMS (SICHERHEIT VON TALSPERREN),
Technische Univ., Munich (Germany, F. R.). Lehrstuhl fuer Wasserbau.
H. Blind.
Wasserwirtschaft, Vol 72, No 3, p 84-90, 1982. 8 Fig, 4 Tab. English Summary.

Descriptors: *Safety, *Dams, *Dam failure,*Design criteria, Dam design, Control systems, Statistics, Data collections, Accidents, Erosion, Subsoil, Flooding, Dam stability, Geology, Hydrology, Hydraulic engineering.

Dam failures and their causes are discussed, and measures to improve the safety of dams are suggested. Registration of all new dams and the reporting of damage thereto is urged so that the analysis of these data may lead to improved design and construction. It is not possible to extrapolate a probability figure for dam failure. Problems with data so far collected (e.g., the International Conference on Large Dams World Register of Dams) include insufficient information, the necessity of using simplified definitions because each case is individual, lack of investigation of the cause of accidents, and differences in environment, design, and construction. Statistics show that causes of failure for earth dams include flooding at high water due to failure of spillways or gates, internal erosion near the foundation, settling of the dam or foundation, contact erosion, inhomogeneity of subsoil, liquefaction, and piping effect; for masonry and concrete dams, causes include insufficient shear strength in the foundation bottom, too great an upward hydraulic pressure on the foundation, lack of stability of the dam, abnormal plasticity of the subsoil and high permeability, and seepage and erosion in the foundation bottom due to permeability. To improve dam safety, certain principles of design and construction should be followed. These include the use of well-qualified engineers and

reliable business firms, thorough site studies, especially in hydrology and geology, careful consideration of design flood and the hydraulic requirements of tail flow, study of the plasticity of the dam and subsoil, a constructive conception of bottom sealing for permeable rock, installation of an observation and control system, the capability of performing future renovations, and the ability to build the dam in a given time. (Gish-FRC)
W82-06236

INFLUENCE OF REMEDIAL MEASURES ON THE MOHNE GRAVITY DAM (EINFLUSS DER SANIERUNGSMASSNAHMEN AUF DIE MOHNEMAUER),
Ruhetalsperrenverein, Essen (Germany, F. R.).
K. -H. Idel, and P. Rissler.
Wasserwirtschaft, Vol 72, No 3, p 130-134, 1982. 4 Fig, 3 Tab, 1 Ref. English Summary.

Descriptors: *Gravity dams, *Renovations, *Grouting, *Drainage engineering, Reservoirs, Mohne reservoir, *West Germany, Maintenance, Seepage, Water pressure, Thermal stress, Strength, Hydraulic engineering, Permeability, Construction, Dam construction, Damage, Aging.

Renovations were carried out on the masonry gravity dam of the Mohne Reservoir, West Germany, between 1972 and 1978 to counteract the destructive effects of aging and of air raids during World War II. In 1943 the middle section of the dam was destroyed in an air attack, and hasty repairs resulted in uncontrollable seepage in this section. Damage appearing in later years included increasing permeability of the dam, damage to the face masonry, thermal stressing of the parapet, and increasing seepage under and around the dam. The greatest permeability was measured in the subsoil of the barrage sides. Comprehensive grouting and drainage procedures were necessary to renew the sealing of the dam and subsoil and to control water pressure distribution in the dam and foundation joint. A work, drainage, and control gallery was constructed at the bottom of the dam wall for grouting. In addition, the head of the wall was compressed from above. Drainage bores were laid out at 1-m intervals to reduce water pressure. The crown of the dam wall was also renovated. A pendulum sounding lead and three single extensometers were installed to measure slippage, and control bores were drilled to measure bottom pressure and seepage. Analysis of slippage measurements made before and after renovations showed greater horizontal slippage after renovation and suggested that compression work had caused an irreversible slippage of the foot of the wall 3-5 mm toward the air side. However, in general, water-level dependent distortion was reduced by the renovations. It was concluded that the dam crown had become stiffer as a result of compression. The drainage system was successful in both removing water and reducing bottom pressure, the latter being important for the shock and slip resistance of the dam. (Gish-FRC)
W82-06239

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMIDICHTUNGEN),
For primary bibliographic entry see Field 8G.
W82-06241

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),
Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8C.
W82-06242

OPTIMAL RISK-BASED HYDRAULIC DESIGN OF BRIDGES,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y.-K. Tung, and L. W. Mays.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 191-203, June 1982. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Hydraulic design, *Bridge design, *Flood damage, Hydraulic structures, Optimization, Risks, Embankments, Leaf River, Hattiesburg, Mississippi, Model studies, Hydrologic models, Highways, Damage, Cost analysis, Backwater, Erosion, Bank erosion, Design criteria, Construction costs.

Hydrologic uncertainties annd socioeconomic effects are incorporated into the hydraulic design of highway bridges to determine the best design for the lowest cost. Using this method, bridge openings and embankment heights can be chosen to avoid overdesign. The cost components involved in risk-based hydraulic design of bridges are construction cost, flood damage cost, backwater damage cost, traffic interruption cost, and embankment repair cost. The optimization technique, the Hooke-Jeeves pattern search, is applied to design of a bridge on the Leaf River near Hattiesburg, Mississippi. Results show that the optimal bridge openings are the same length for the various probability models (normal, lognormal, Gumbel, Pearson III, log-Pearson III, and composite) and parameter estimation procedures, but the embankment heights vary by 1.8 ft. In this example the jacknife and bootstrap methods produce nearly the same optimal solutions. Construction costs were computed at $217,800 and expected annual damage costs from $55,000 to $110,800 depending on the hydrological probability model used. (Cassar-FRC)
W82-06432

PROBLEMS IN TUNNELLING BY PIPE JACKING AT TILEHURST,
Thames Water Authority, London (England).
S. H. Shurlock.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 151-153, March, 1982. 2 Fig.

Descriptors: *Tunnel failure, *Pipe jacking, Tunnel construction, Tunneling, Reading, England, Tilehurst.

Pipe jacking was the technique chosen for a 130 m tunnel project, part of a new outlet system from the Tilehurst service reservoir at Reading, England. The tunnel drive began through stiff blue London Clay. After 10 m brown clay appeared and at 24 m the face collapsed, dumping 3 cu m of gravel and soft clay plus a large quantity of water. The blue clay layer totally disappeared and wet conditions prevailed thereafter. After 37 m into the tunnel some joints were broken or displaced, and gravel and water became a constant problem. Of 54 joints, 19 were visibly damaged and 6 others showed groundwater inflow. The tunnel varied from a straight line by + or - 72 mm in level and + or - 84mm in line. Direction changes reached the 1 degree maximum recommended deflection. A welded steel lining was eventually inserted to repair the damage. The actual tunnel cost was 112,000 pounds vs. the planned 72,000 pounds. Several conclusions were reached from this experience: (1) test boreholes should have been much closer together, (2) pipe jacking is a good procedure, but the joints are a major weakness, (3) existing techniques are suitable for short drives but not adequate for long drives unless very good conditions prevail, and (4) apparently sound joints can be badly spalled on the outside. (Cassar-FRC)
W82-06448

THE APPLICATION OF MICROCOMPUTERS TO THE DESIGN OF STORM SEWER SYSTEMS FOR SMALL AREAS,
Sunderland Polytechnic (England). Dept. of Civil Engineering.
B. Archer.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 113-117, March, 1982. 5 Ref.

Descriptors: *Sewer systems, *Pipes, *Drainage systems, Computers, Design criteria, Rainfall intensity, Urban drainage, Storm sewers.

Microcomputers can advantageously be used to design storm sewer systems. Charts and tables for pipe sizing and for rainfall intensity are replaced by rapid calculations from the basic equations. Pipe sizes are determined within seconds, compared with the several hours necessary for manual methods involving tables. Effects of changing depths, pipe inverts, pipe lengths, or areas to be drained can be quickly determined. An appendix describes the outline flow chart for the prgrams, lists the program, and illustrates use of the program. (Cassar-FRC)
W82-06449

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-06452

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,
University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
For primary bibliographic entry see Field 5F.
W82-06453

MAJOR FACTORS IN SEWER VENTILATION,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. B. Pescod, and A. C. Price.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 385-397, April 1982. 10 Fig, 9 Tab, 4 Ref.

Descriptors: *Sewer systems, *Ventilation, *Air circulation, Temperature effects, Corrosion, Hydrogen sulfide, Dissolved oxygen, Corrosion control.

As part of an effort to develop a design to produce a maximum ventilating air flow within a sewer system having ventilation stacks without using mechanical means, an investigation of the major factors affecting naturally-occurring air flows in sewers and undertaken. The five factors considered to be the major contributors to sewer ventilation are the action of wind passing across the ventilation stack, the friction at the air-water interface resulting from the wastewater flowing down the sewer (wastewater drag), the rise and fall of the wastewater level, temperature differentials between the air and the sewer, and differences in the barometric pressure across various parts of the system. The influence of the last three factors can be treated in an analytical manner by representation in terms of the volume of air turnover produced by the rise and fall of the wastewater, having either assumed or measured a pattern of flow, or as an additional driving pressue head in the cases of the temperature and baromeric pressure differentials. Full-scale ventilation stacks were tested in a low-velocity wind tunnel using various terminals for the educt stack to try to find a stack shape which would maximize the wind across stack effect. The wastewater drag effect was investigated through measurement of air velocities using a gas tracer technique. The wind tunnel tests resulted in the identification of extraction rates that can be produced by low wind speeds at the educt stack location from which a typical daily or weekly extraction rate can be estimated under natural conditions. The wastewater drag effects appear to be subservient to wind extraction. The variability of wastewater level in a sewer system results in addition fresh air being drawn in during a fall in level and sewer air being exhausted during a rise in level. Temperature differentials in the summer can be expected to increase resistance to air movement in the sewer. Significant differences in barometric pressure would not be expected to arise during the summer months in the United Kingdom. (Carroll-FRC)
W82-06462

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,
P. J. Mason.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 209-219, May, 1982. 4 Fig, 44 Ref.

Descriptors: *Energy dissipation, *Dam design, *Outlets, Flip buckets, Hydraulic design, Ski jumps, Jets, Damage, Erosion, Cavitation, Hydraulic jump, Discharge capacity, Rock basins, Baffles.

A survey was conducted at 370 prototype energy dissipators from dams in 61 countries to establish the ranges of head and flow for which designers have selected various dissipators and at which problems are most likely to occur. Rock basins are predominantly used for head differences below 30 m. Damages are most likely at head differences above 40 m or in the presence of weak rocks. Simple hydraulic jump stilling basins in concrete are commonly used at head drops of 1-10 m and 30-50 m. At 50 m or above special techniques and materials are necessary to avoid failure. Baffle basins, generally trouble-free over a head drop range of 10-30 m, show erosion, cavitation, and complete destruction at higher head differences. Free trajectory jet dissipators (simple overfalls, ski jumps, and flip buckets) are relatively problem-free for almost any head drop, over 200 m in some cases. A few reported cases of erosion are related to unacceptable scour in the downstream plunge pool. One case of cavitation erosion is documented. A graph shows that free trajectory jet dissipators are rarely used in the range to the left of a line defined by a head drop of 8 m and discharge capacity of zero and a head drop of 48 m and discharge capacity of 10,000 cu m per sec. Results of this survey are summarized on a graph revealing the most practical energy dissipator designs for different combinations of head drop and discharge capacity. (Cassar-FRC)
W82-06500

THE KIELDER TRANSFER WORKS,
D. J. Coats, N. S. M. Berry, and D. J. Banks.
Proceedings of the Institution of Civil Engineers, Part 1, Design and Construction, Vol 72, No 2, p 177-208, May, 1982. 24 Fig, 3 Tab, 38 Ref.

Descriptors: *Pipelines, *Tunnel construction, *Water transfer, Tunnel linings, Kielder Dam, *England, Tees River, Wear River, Tyne River, Water resources development, Reservoirs, Weirs, Pumping plants, Dam construction, Aqueducts, Hydraulic valves.

The transfer works of the Northumbrian Water Authority Kielder water scheme connects the water stored at Kielder Water on the River North Tyne with the rivers Wear and Tees for purposes of flow regulation and water abstraction. Operations are scheduled to begin in 1982. Water abstracted from the River Tyne at the Riding Mill pumping station 56 km downstream from Kielder Dam will flow through 6.2 km of pump main and 32 km of a gravitational system, with connections at the rivers Wear and Tees. The Airy Holm headpond, about 8 km from Riding Mill, permits correction of imbalances between rates of pumping and tunnel discharge. At Riding Mill weirs have been installed to increase the water depth and provide storage. The pumping station contains 12 pump units, each with 91,000 cu m per day capacity. The 65 m long intake has a maximum intake velocity of 0.3 m per sec. The steel pump main rises about 200 m. Air venting houses and access places for cleaning are built into the pipeline. The Airy Holm dam was built with a 180 m long and 20 m high concrete gravity section in the central portion, with earth embankments on the flanks to give a dam 500 m long. A concrete-lined gravity flow tunnel with air shafts and discharge valves at the rivers complete the transfer works. Steel pipe 2.89 m in diameter carries the aqueduct over two river valleys. There are no in-line valves, all control being effected by the discharge valves at the rivers Wear and Tees. The discharge structures are largely underground. (Cassar-FRC)
W82-06502

THE KIELDER WATER SCHEME,
D. J. Coats, and N. J. Ruffle.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 135-147, May, 1982. 5 Fig, 1 Tab, 5 Ref.

Descriptors: Water resources development, *Flow regulation, *Water transfer, Kielder Reservoir, Tyne River, Wear River, Tees River, *England, Reservoirs, Flow augmentation, Recreation, Environmental effects, Water storage, Industrial water, Water supply, Aeration, Water quality control, Public relations, Fish.

The Kielder water scheme was constructed during 1975-82 in northeast England to regulate the Rivers Tyne, Wear, and Tees for supplying water to a region with rising industrial water usage. It is under the jurisdiction of the Northumbrian Water Authority. Kielder Water, a 188 million cu m reservoir on the River North Tyne, provides water for regulation of all three rivers via a north-south transfer works. This consists of a weir and pumping station on the River Tyne, 6.2 km of 2 m diameter pumping main, 32 km of 2.9 m diameter tunnel, and a small head pond at Airy Holm. Aeration was installed in the reservoir to prevent thermal stratification and resulting problems from Fe and Mn compounds, sulfides, and ammonia. During construction truck traffic was limited to an approved route. Public relations with the community remained good throughout construction because of Liaison Officer, located near the headworks, was available for resolving problems and for guiding visitors. Prehistoric, Roman, and medieval sites were investigated before innundation, and the historic 1862 Kielder Viaduct was preserved. The irregularly shaped 1086 ha reservoir, set in coniferous forest, is available for recreational activities such as fishing, boating, camping, and other activities. Since much salmon spawning gravel was inundated, a fish hatchery has been built upstream to release 160,000 juvenile salmon per year. (Cassar-FRC)
W82-06503

THE KIELDER HEADWORKS,
D. J. Coats, and G. Rocke.
Proceedings of the Institution of Civil Engineers. Part I, Design and Construction, Vol 72, No 2, p 149-176, May, 1982. 21 Fig, 2 Tab, 4 Ref.

Descriptors: *Dam construction, *Reservoirs, *Embankments, Kielder Dam, Bakethin Dam, England, Earth dams, Weirs, North Tyne River, Culverts.

Construction details of the Northumbrian Water Authority's Kielder Water are described. This reservoir is part of a scheme to regulate the River Tyne in northeast England. Construction work started in 1975 with relocation of a highway. Preliminary site studies revealed an underlying rock sequence of sandstones, shales, mudstones, and coal seams. The superficial deposits were glacial boulder clay and alluvial material. Bakethin Dam, a 17 m high and 165 m long submerged sand and gravel weir, was built within the main reservoir to retain water in the upper reaches for amenity reasons when Kielder Water is drawn down. The draw-off works consists of a reinforced concrete culvert about 15 m wide containing a 1900 mm diameter scour pipe, a 2000 mm diameter draw-off pipe, an access roadway, instruments, and a valve tower. Construction details and diagrams of the clay core, earth-fill Kielder Dam are described. The dam is 1140 m long, 52 m high. The reservoir is 11.1 km long, 1086 ha in surface area, and stores 188 million cu m of water. Impounding started on December 15, 1980. (Cassar-FRC)
W82-06504

BRIDGING THE WATER SUPPLY GAP,
Bogert (Clinton) Associates, Fort Lee, NJ.
W. Wheeler, and E. Cruz.
Public Works, Vol 113, No 3, p 62-63, March, 1982.

Descriptors: *Pipelines, *Water supply, *Water transfer, Construction, New York, New Jersey, Drought, Bridges, George Washington Bridge, Expansion, Water shortage.

Water from New York's supply system was diverted to drought-stricken northeast New Jersey by a 10,5000 ft long, 24 inch diameter steel pipeline built acress the George Washington bridge over a 4-month period. It was completed on July 1, 1981. The pipeline has a capacity of 20 mgd. Special problems included 9 ft. of expansion and constraction and a 7 ft. sway, heavy vehicular traffic on the bridge (250,000 vehicles per day), the age of the bridge (50 years), and procuring the necessary materials, Since custom expansion joints could not be disigned and made within the time limits, units with 10 inch axial movement each were combined, five for the 48 inch movement at the main span of each tower and two for the 18 inch movement at the side spans. The pipeline is anchored to the bridge only at the center, the unanchored part floating on roller guides. If desired, the pipeline may be dismantled and stored in an abandoned tunnel. (Cassar-FRC)
W82-06508

TEXAS GULF COAST PROJECT ANSWERS VITAL WATER NEED,
Southwest and Texas Water Works Journal, Vol 64, No 2, p 6-7, May, 1982.

Descriptors: *Water supply, *Pipelines, *Reservoirs, Dams, Point Comfort, Texas, Earth dams.

A pipeline and reservoir system is currently under construction to supply water to the Point Comfort region near Houston, Texas. The project consists of the earth-filled, 1.3 mile long, 58 ft high Palmetto Bend Dam, the 11,000 acre Lake Texana, one mile of 36 inch steel above-ground transmission line, and 13 miles of underground pipeline. The dam is constructed with specially covered slopes and extra steel anchors in the concrete spillway to protect against hurricane damage. Initially the reservoir will provide 20,000 acre ft of water per year to the region. (Cassar-FRC)
W82-06519

STANDARD PRACTICE FOR INSERTION OF FLEXIBLE POLYETHYLENE PIPE INTO EXISTING SEWERS--ASTM F585-78.
Water Services, Vol 86, No 1033, p 106-108, March, 1982. 2 Fig, 6 Ref.

Descriptors: *Pipelines, *Sewer systems, *Rehabilitation, Plastics, Standards, Excavation, Inspection, Flow characteristics, Design criteria, American Society for Testing and Materials.

The standard practice reprinted and adapted here (ASTM F585-78) describes the design and selection considerations and installation procedures for construction of new sanitary and storm sewers by inserting polyethylene pipe through existing pipe and along the previously existing line and grade. This procedure minimizes traffic disruption, surface damage, and restoration, with little or no interruption of service. General guidelines emphasize that existing pipe conditions must be determined to see if the pipe insertion is feasible. Generally, piping with outside diameter 10% smaller than the original sewer is practical. To account for external loading, formulas are given for calculating the standard dimensiion ratio of pipe required and the minimum allowable radius of curature for any size and weight of pipe. Other subjects treated under design and selection characteristics are anchoring and encasement, pulling force and length. Procedures are detailed for inspection and cleaning; excavation; storage, handling, and joining of polyethylene pipe; insertion and termination; finishing and restoration; and inspection and acceptance. (Cassar-FRC)
W82-06601

OUT OF SIGHT--OUT OF MIND.
Civil Engineering (London), p 45, 47, May 1982. 1 Tab, 2 Ref.

Descriptors: *Tunnel linings, *Rehabilitation, *Sewer systems, Linings, Polyester resins, Resins, *England.

Rehabilitation of aging sewers in England has generally been limited to repairing acute failures with the limited available funds. Relining with polymers has been receiving increased attention in spite of its high initial cost. A comparison of the costs for installing several types of polyester concrete, glass reinforced polyester, and other methods showed that these relining methods are generally 4-5 times more expensive than hand repointing. Since relining is still in its infancy, many contractors use it only in sections unsuitable for digging. The problem of detecting voids around the barrel of the sewer is being studied. Base-band radar and gamma ray backscatter have been successful in locating dry voids. Closed-circuit television has also been used to view the condition of the sewer interiors. (Cassar-FRC)
W82-06713

CANAL TUNNEL REPAIR OPTIONS.
Civil Engineering (London), p 56, 58, May, 1982. 1 Fig.

Descriptors: *Tunnel linings, *Canal linings, *Rehabilitation, Linings, Concrete construction, Blisworth Tunnel, *England.

The 2812 m long brick lined Blisworth tunnel, part of Britain's 2000 mile canal system, has been closed to boat traffic since October 1980 because of failures and deterioration. The option chosen for rehabilitation of the 200-year-old structure involves removal of a section of existing tunnel lining and some of the surrounding material and replacing this with an external segmental concrete lining. Although the 4.25 million pound cost is the most expensive of the five renovation alternatives in the short term, maintenance is expected to be minimal. In addition the tunnel's 15 ft width will not be further reduced, retaining the 2-way traffic pattern. Work is expected to start in late 1982. (Cassar-FRC)
W82-06758

SEWER RENEWAL BY PIPE INSERTION.
Civil Engineering (London), p 66-67, May, 1982.

Descriptors: *Sewer systems, *Linings, *Rehabilitation, Polyethylene, Pipes, Plastics.

Insertion of polyethylene pipe into aging sewers provides total renewal for structurally unsound systems as well as corrosion resistance. The winching method of insertion can be used for lengths up to 500 m without diverting flows. Hydraulic jacking needs an insertion pit only 1 m longer than an individual section. However, it is more expensive because smaller lengths and more joints are required. Flows must be diverted. In high water table regions no dewatering or trenching is necessary. There are minimum disturbances to agricultural crops, buildings, and traffic. The small decrease in finished pipe diameter is counteracted by the low friction, infiltration resistant smooth plastic lining. (Cassar-FRC)
W82-06759

REDEVELOPMENT OF AQUEDUCT CROSSING OF MANCHESTER SHIP CANAL AND RIVER MERSEY,
R. J. Baty.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 97-112, March, 1982. 6 Fig.

Descriptors: *Aqueducts, *Tunnel construction, Pipelines, Tunnel linings, Frozen ground, Manchester Ship Canal, Mersey River, Vyrnwy Aqueduct, Diversion structures, *England.

The aqueducts crossing the Manchester Ship Canal and the River Mersey were first put into service in 1892. The section under the canal was a 3658 mm diameter brick tunnel, built before the ship canal was filled with water. The section under the river was a 2748 mm diameter tunnel built of cast-iron sections bolted together. Within these tunnels pipelines were installed in 1892 and 1905. A third pipeline, added in 1938, fit within the canal tunnel. However, in order to pass under the river it was necessary to construct a second tunnel crossing the Mersey. Water resources developments during the 1960's required further modifications to the system. Deterioration of some of the old pipe necessitated remedial work. The North West Water Authority accomplished this by linking the two existing river crossing tunnels and replacing the pipes with a single pressure lining occupying the full area of the tunnel. This paper discribes the reconstruction work in detail. After construction of a temporary diversion pipework, the connecting shaft was built using a local ground freezing technique and precast concrete segments. The old brickwork and cast-iron segment tunnels, in excellent condition, were lined with pressure-resistant steel 16 mm thick in 6 and 3.6 m lengths. At the tops of the shafts shear walls penetrating the bedrock were constructed to compensate for thrust forces. The project began in October 1978 and was completed in spring 1981. (Cassar-FRC)
W82-06813

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),
Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).
J. Bauer.
Wasserwirtschaft, Vol 72, No 1, p 6-11, 1982. 7 Fig.

Descriptors: *Airports, *Hydraulic engineering, *Diversion ditches, *Water table, *Wastewater facilities, Storm wastewater, Storm sewers, Drainage ditches, Drainage effects, Environmental effects, Construction, Engineering, Agriculture, *West Germany, Drinking water, Soil mechanics, Geology.

Water-related problems caused by the site selection for the new Munich (West Germany) airport and the solutions to these problems are described. The site is at the northern edge of the Munich gravel plain, with a topsoil that was once peat but is now used for intensive agriculture. Under the permeable quaternary gravel lies an impermeable layer that separates the groundwater into upper and lower regions, the lower region being used for drinking water. It was important that airport construction not disturb this arrangement. Several small streams running from southwest to northwest would be diverted around the airport by channels built to a design flood of 20 years, the main outfall ditch being built to a 100-year flood. The airport would also be protected by a dike along the channel walls. The groundwater table would be lowered by means of drainage ditches to prevent frost formation on the runways. In order to avoid a negative effect on the surrounding agricultural lands, a plan was chosen such that the lowering of the water table is only noticeable to the south (upstream) of the airport, and then only after a long dry spell; in order to avoid negative effects to the north, water collected in the drainage ditches would be allowed to seep out through 120 vertical shafts along the northern perimeter of the airport. Stormwater would be channeled into a combined system for domestic and industrial wastewater as well as stormwater from streets and parking lots and a separate stormwater system for lightly polluted stormwater and stormwater overflow. The construction of an underground rail line connecting the airport with the city posed the problem of avoiding a build-up of groundwater, since the tunnel would cut off its flow. It was decided to collect water on the upstream side in horizontal filters and carry it to downstream horizontal filters by means of control shafts along the tunnel walls which would be connected to deep siphons. (Gish-FRC)
W82-06825

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
For primary bibliographic entry see Field 6B.
W82-06869

HYDRAULIC MODEL STUDIES - YELLOWTAIL AFTERBAY DAM SLUICEWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. F. Young.
Report GR-82-5, July, 1982. 47 p, 24 Fig, 2 Tab, 3 Ref.

Descriptors: *Supersatuation, *Hydraulic models, *Dam effects, *Gases, *Flow deflectors, *Sluiceways, Model studies, Fishkill, Dam design, Stilling basins, Flow velocity, Debris, *Montana.

Yellowtail Afterbay Dam is on the Big Horn River 3.5 km below Yellowtail Dam and Powerplant. Releases from the afterbay dam are used to provide uniform daily flow in the Big Horn River, leveling the peaking power generation from Yellowtail Powerplant. At times, gas supersaturation has occurred downstream from Yellowail Afterbay Dam, resulting in serious fish kills. A 1:24 scale model of Yellowtail Afterbay sluiceway was constructed to study the placement of flow deflectors designed to keep the water jets issuing from the sluiceway gates near the tailwater surface. Deflector plates installed on the curved invert of the sluiceway will reduce jet submegence, a cause of supersaturation. Measurements show no subatmospheric pressures present on the flow deflector lips. Waves within the stilling basin will be larger with the deflectors in place than with the existing configuration, while waves outside the basin will be the same size or smaller. With the flow deflectors in place, the largest velocities, and therefore the most flow, occur near the surface where the pressure is close to atmospheric. With the deflectors in place, material will not be brought back into the basin, although any material thrown into the basin will remain there. (Moore-SRC)
W82-06962

8B. Hydraulics

ON CONDUCTING THE MODIFIED 'SLUG' TEST IN TIGHT FORMATIONS,
Geological Survey, Reston.
C. E. Neuzil.
Water Resources Research, Vol 18, No 2, p 439-441, April, 1982. 5 Fig, 3 Ref.

Descriptors: *Well hydraulics, *Hydraulic properties, *Test wells, *Rock mechanics, Permeability coefficient, Storage coefficient, Equilibrium, Head loss, Compressibility, Transmissivity, Wells, Hydraulics, Shales, Pumps, Slug test.

An improved version of a modified 'slug' test (Brdehoeft, J. D., and Papadopulos, S. S., 'A method for determining the hydraulic properties of tight formations, 'Water Resources Research, Vol. 16, No. 1, p 233-238, 1980) is presented. With the original method, the borehole is filled with water prior to the test, usually resulting in significant transient flow; the necessary condition of approximate equilibrium is therefore not met. Additionally, while the compressibility of water (Cw) should be used to account for storage change in the shut-in well, actual compressibility in this well can be larger than Cw. With the improved method, the borehole is filled with water and two packers are placed close together. Pressure is monitored by two transducers, one between the packers and one below the lower packer. The test section is shut in, and pressures in both sections are monitored until near-equilibrium exists. To compute compressibility in the well, the volume of water pumped in to achieve the pressure 'slug' must be known; this is calculated by measuring the amount of water pumped from a container at the surface. The possibility of generating a suction in the uppermost part of the shut-in volume and the creation of a free surface is prevented by locating the valve used to shut the well near the packers. (Gish-FRC)
W82-06060

BICYCLE-SAFE GRATE INLETS STUDY; VOLUME 5 - HYDRAULIC DESIGN OF GENERAL SLOTTED DRAIN INLETS,

Water and Power Resources Service, Denver, Colorado.
C. A. Pugh.
Federal Highway Administration Report FHWA/RD-80/081, October 1980. 145 p, 120 Fig, 6 Tab, 1 Ref. PO-5-3-0166.

Descriptors: *Inlets, *Hydraulic design, *Hydraulic models, *Storm drains, Model studies, Flow characteristics, Interception, Slopes, Flow capture.

Hydraulic tests and analysis were conducted to generalize the hydraulic design of slotted drain installations. Slotted drains with solid vertical spacers at 6-in spacing were used in all testing. Slot widths of 1, 1.75, and 2.50 inches and slot lengths of 8, 24 and 48 ft were used. The tests at slot length of 8 and 24 ft whose conducted to determine efficiencies over a range of flows. At 48 ft, testing was limited to total flow capture lengths. In order to cover a range of slope conditions, logitudinal slopes of 0.005, 0.02, and 0.09 were tested at cross slopes of 1/16, 1/32, and 1/64. Back slopes of 1/16 and 1/24 were tested at a curb distance of 15 in for all installations. All installations were also tested with the curb adjacent to the slot. A series of 4 or 5 discharges ws tested for each condition. For most field conditions weir flow controls the total capture length. Based on data from these studies, new equations were developed to cover a wider range of conditions. Back slope does not affect the partial flow interception efficiency in the range measured. (Moore-SRC)
W82-06095

CANALS IN SAND CHANNELS,
S. Kh. Abal'yants.
Hydrotechnical Construction, Vol 15, No 8, p 471-475, 1981. 1 Fig, 2 Tab, 19 Ref. Translated From Gidrotekhnicheskoe Stroitel'stvo, No 8, p 28-30, August, 1981.

Descriptors: *Canal design, *Mathematical studies, *Flow characteristics, *Hydraulics, *Channel flow, *Channel morphology, *Flow velocity, Canal construction, Design criteria, Stable channels, Canals, Flow friction, Mathematical equations, Roughness coefficient, Chezy equation, Sand, Canal linings, Channel erosion.

The mobility of material in a canal constructed in noncohesive sand soils is substantially affected by the turbulence of the flow, a factor not adequately reflected in the working formulas. Preliminary data indicates that Studenichnikov's formula for the critical velocity with a slightly reduced numerical coefficient and replacement of depth by the hydraulic radius without corrections for the channel shape is applicable for sands with a particle size to 1.5-2.0 mm. Equations were formulated establishing the existence of a stable quasihomogeneous flow whose conditions can be regarded as an expression of minimum energy dissipation. The influence of the roughness coefficient on the equations' parameters is discussed. Other factors such as traveling surges, wind and ship waves, local curves of the route, infiltration, nonuniform strength properties of the soils, and special conditions of the winter regime should also be considered when designing and constructing new canals. (Geiger-FRC)
W82-06196

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W82-06227

CAVITATION PROBLEMS IN HIGH-HEAD INSTALLATIONS (KAVITATIONSPROBLEME IN GRUNDABLASSEN),
Karlsruhe Univ. (Germany, F. R.). Inst. fuer Hydromechanick.
E. Naudascher.
Wasserwirtschaft, Vol 72, No 3, p 104-110, 1982. 14 Fig, 27 Ref. English Summary.

Descriptors: *Cavitation, *Design criteria, *Dams, Fluid mechanics, Erosion, Bottom outlets, Mathematical equations, Water currents, Vortices, Eddies, Flow, Turbulent flow, Aeration, Shear, Pakistan, *High-head installations.

The significance of cavitation for high-head installations was demonstrated by the collapse of a bottom outlet of the Tarbela Dam in Pakistan in 1974, which was caused by erosions of up to 5 m under the inlet structure and hollowing out of the piers. Damage from cavitation sets in principally when, in addition to the usual preconditions, vortex formations occur. Equations for calculating the cavitation figure (Ka), an estimate of the onset of cavitation, its extent and consequences, and for the size of Ka at the onset of cavitation (Ka krit) are given. Areas particularly susceptible to caviation are current boundaries with crooked edges or breaks. Shear zones form along the breaks in which turbulent vortices form. An equation to calculate Ka krit along smooth and rough walls and in free shear currents is given. Other conditions under which cavitation occurs are discussed. Design principles for avoiding cavitation are the streamlining of flow passages to keep pressure and velocity of the current within acceptable limits, the transfer of zones favoring cavitation to the inner areas of the current so that the walls are protected from erosion, and artificial aeration as well as the fostering of spontaneous aeration. Examples of all these principles are described and illustrated, and special protection measures and extraordinary operating conditions are discussed. Further research on the behavior of currents is called for. (Gish-FRC)
W82-06237

DESIGN FLOOD AND HYDROLOGICAL RISK FOR SPILLWAYS OR RESERVOIRS AND FLOOD PROTECTION BASINS (BEMESSUNGSHOCHWASSER UND HYDROLOGISCHES VERSAGENSRISIKO FUR TALSPERREN UND HOCHWASSERRUCKHALTEBECKEN),
Karlsruhe Univ. (Germany, F. R.). Inst. Wasserbau III.
E. J. Plate.
Wasserwirtschaft, Vol 72, No 3, p 91-97, 1982. 6 Fig, 14 Ref. English Summary.

Descriptors: *Design criteria, *Reservoirs, *Flood protection, *Dam failure, *Spillways, Floods, Flood control, Flood plain management, Risks, Reliability theory, Mathematical analysis, Design standards, Standards, Maximum probable floods, Hydraulic design, Reservoir design, Costs, Acceptable risk.

A concept for improving the design of spillways is presented, which can be used to supplement the rules of German Standard DIN 19700 for reservoirs and flood protection basins. The Standard is not far-reaching enough because its only design criterion is the probability of flood waters exceeding reservoir capacity, whereas the probability of dam overflow should also be considered, since there is no direct connection between the two. The first stage of the concept consists of calculating the overflow probability, which is also the probability of dam failure due to hydrological causes, by means of Freudenthal's reliability integral. The use of reliability theory leads to significantly longer recurrence intervals of overflow than those previously calculated. Sample calculations are given for a small potable-water reservoir, giving a recurrence interval of 34,528 years, and for a small flood protection basin, giving an interval of 642 years. Whether the small interval of the second example is significant or not depends on the damage that would be caused by overflow, and this leads to the second stage of the concept, that of acceptable risk. Rather than measuring total damage done by one flood, hydrological risk should be understood as a figure proportional to the expected value of damage expected per year following overflow. Methods of determining this are given, though as yet no concept exists to measure the acceptable level of non-monetary damage. This total concept can aid in economical design and help satisfy public demand for knowledge or risks to which they are subjected. (Baker-FRC)
W82-06238

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN),
Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
H. J. Hoch.
Wasserwirtschaft, Vol 72, No 3, p 110-114, 1982. 11 Fig, 6 Ref. English Summary.

Descriptors: *Jets, *Bottom outlets, *Gates, Model studies, Reservoirs, Plumes, Hydraulic design, Design criteria, Hydraulic engineering, Cavitation, Trails, Water currents, Tunnels, Irrigation, Irrigation engineering, *Sri Lanka, Rangenigala Reservoir.

Model studies were conducted to examine the confluence of jets behind two parallel segment gates in the bottom outlet of the Rangenigala Reservoir, Sri Lanka. The bottom outlet also functions as an irrigation outlet, which necessitated the construction of two gates at the end of the pressure tunnel for operational safety. The result of this is separation of flow by a dividing wall which for static reasons must be 2.6 m wide. Because of the high velocity (43.2 m/sec) of the two jets, which converged at a relatively large angle behind the wall, water plumes of up to 15 m in height ensued under certain conditions when an elliptical model wall was used. Theoretical calculations and reference to previous experiments led to a model in which pier width was kept constant at 2.6 m under the segment gates. Though the effect of jets crashing into each other when both gates were equally open and against the opposite channel wall when the gates were open at different levels was reduced by 70%, and a narrow plume of only 5 m in geight was formed, these conditions were not adequate to ensure the safety of the nonpressure tunnel. For this reason an extension to the wall was built, 35 m in length, with a height of 1.9 m at the wall, diminishing to 0.5 m. In this way the lower portion of the jet was channeled, while the upper portion gradually broadened out along the extending trail, and in the area of jet convergence water depth and Froude number were constantly changing. This trail was an improvement on previously built rails in that its side walls ran at an angle of 1 degree so that the flow cross-section of the jet broadened continuously, its form was prismatic to fix separation of flow along the edges, and it had a box profile to allow aeration of the trail end for the avoidance of cavitation. (Gish-FRC)
W82-06243

HYDRAULIC JUMP, AIR ENTRAINMENT AND SLUG FLOW IN BOTTOM OUTLETS (WECHSELSPRUNG, LUFTEINTRAG UND SCHWALLFORMIGER ABFLUSS IN GRUNDABLASSEN),
Technische Univ., Munich (Germany, F. R.). Versuchsanstalt Fuer Wasserbau.
J. Knauss.
Wasserwirtschaft, Vol 72, No 3, p 115-119, 1982. 6 Fig, 1 Ref.

Descriptors: *Bottom outlets, *Air entrainment, *Hydraulic jump, *Closed-conduit flow, *Slug flow, Fluid mechanics, Flow, Flood protection, Vibrations, Supercritical inflow, Submerged outflow, Ventilation, Model studies, Design criteria, Hydraulic design, Hydraulic engineering, West Germany.

Conditions under which slug flow can occur and possible remedies for the situation are discussed with reference to operational installations planned for the flood protection basin at Schonstadt an der Itz, West Germany. Slug flow can arise in closed channels when submerged outflow conditions act on supercritical inflow so that a hydraulic jump fills the conduit. The consequences of this are dynamic stress reversals in the conduit, pulsating and discontinuous flow, and the danger of vibrations. Model studies showed that the planned positioning of the spillway and two bottom outlets close together on top of one another in a single casing under the dam would lead to slug flow due

to a hydraulic jump entraining air within the conduit. Two remedies were possible, changing the outlet route or installing ventilation units to remove the entrained air. Because in this case air entrainment was unavoidable due to gate position and accumulation in the channel, it was decided to build two ventilation units in each bottom outlet. In this case the bottom outlets had an inclination of 5% and a cross-section of 2 x 2 m; the model studies also investigated channel inclinations of 3%, 6% and 12% with prismatic cross-sections of 20/15 cm (compact) and 20/30 cm (superelevated). Installation of ventilation systems may be avoided by designing bottom outlets with an appropriate vertical route for the channel to prevent accumulation. (Gish-FRC)
W82-06244

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1.
For primary bibliographic entry see Field 3F.
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,
For primary bibliographic entry see Field 3F.
W82-06376

CANADIAN WAVE CLIMATE STUDY: ORGANIZATION AND OPERATION,
J. R. Wilson, and W. F. Baird.
Marine Sciences and Information Directorate, Manuscript Report Series No 59, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 26 p, 9 Fig, 1 Tab, 31 Ref.

Descriptors: *Wave height, *Wave propagation, *Data collections, *Design criteria, *Breakwaters, Canada, Wave action, Wave crest, Wave direction, Waves, Kinematic waves, Wind waves, Buoys, Structural engineering, Port facilities, Histograms, Data acquisition, Data interpretation, Design standards, Sea walls.

The Canadian Wave Climate Study was established in 1968 to provide information to assist the design of marine facilities (e.g., deep water ports, breakwaters, offshore structures), and has led to wave data collections at about 200 locations in marine and inland waters on both the east and west coasts of Canada. Recent activities have led to the development of a standard analysis procedure and a set of data presentations useful to design engineering. These activities are delineated, along with the instrumentation employed, its reliability, and its operation characteristics. Specifically, the performance and calibration of the basic instrument employed, the waverider buoy, are described. Calibrations were carried out with a variable-speed mechanical oscillator capable of rotating a waverider in a fixed plane at a number of selectable fixed frequencies. Data control and analysis are discussed, and examples of data reporting products are given (e.g., scatter diagrams, peak-period histograms, wave height exceedence diagrams, wave height time-course plots, spectrum diagrams, surface elevation traces). In addition to the standard data products, wave data are available on magnetic tape in digital form in both computed spectral and surface elevation files (covering over 300,000 records in each of these files). (Zielinski-MAXIMA)
W82-06393

SEWER NETWORK ROUTING BY DYNAMIC WAVE CHARACTERISTICS,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
A. S. Sevuk, and B. C. Yen.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 379-398, March, 1982. 13 Fig, 3 Tab, 12 Ref.

Descriptors: *Routing, *Sewer hydraulics, *Wave action, *Flow characteristics, Unsteady flow, Simulation anlaysis, Mathematical models, Networks.

Although flow in storm sewer networks is usually unsteady, nonuniform, turbulent, and subject to mutual backwater effects of joining sewers, it is only recently that complete dynamic wave equations capable of accounting for the downstream backwater effect have been adopted in sewer network flow simulation. Numerical schemes for solving the dynamic wave equations are computationally costly and at times unstable. The Illinois Storm Sewer System Simulation Model uses the method of characteristics to solve these dynamic wave equations. The use of this model to route unsteady open-channel flow in dendritic sewer networks is reported. Application of the model to a 48-pipe sewer system confirmed the following characteristics of unsteady open-channel flow in sewer networks: the backwater effect of the junctions cannot be ignored in modeling these systems and, under certain circumstances, reversal flow may occur; the depth-discharge relationship is not unique and a loop-type rating curve exists; and the occurrence of maximum discharge in a sewer need not, and usually does not, coincide with maximum depth. The model is also applied to the example sewer network given in an American Society of Civil Engineers Manual of Engineering Practice in order to demonstrate how a dynamic wave routing model can be used to evaluate and improve a sewer system. Although several refinements to the model are desirable, the computed results of the model presented appear to be in good agreement with the expectations based on physical reasoning. (Carroll-FRC)
W82-06418

DILUTION ANALYSIS FOR UNIDIRECTIONAL DIFFUSERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 327-342, March, 1982. 9 Fig, 18 Ref.

Descriptors: *Diffusion coefficent, *Wastewater disposal, Cooling water, Mixing, Prediction, Mathematical studies, Powerplants, Design criteria, Flow discharge, Fluid mechanics.

Submerged multiport diffusers provide an efficient means for the rapid dilution of large volumes of wastewater discharged into ambient receiving waters. The mixing mechanics of two types of unidirectional diffusers used to discharge heated water from steam-electric powerplants into shallow, laterally unbounded receiving waters are examined. The diffusers analyzed include a coflowing diffuser, in which the discharge ports are oriented in the direction of the ambient current, and a tee diffuser, in which the discharge ports are oriented at right angles to the ambient current. An analytical theory for the dilution of a coflowing diffuser has been developed and was shown to yield good agreement with available measurements. Comparison of this theory with anlaysis governing other diffuser types indicated that the coflowing diffuser is the best choice for maximizing dilution in open receiving waters with predominant currents in one direction. The symmetrical orientation of a tee diffuser makes it the preferred choice over a coflowing diffuser when the receiving waters are characterized by weak bidirectional currents. A semi-empirical theory was used to illustrate the dependence of tee difusser dilution on ambient current speed, suggesting that the highest practical discharge velocity should be used to obtain the most efficient mixing with this type of diffuser. Comparison of dilution obtained with a tee diffuser with that expected for staged diffuser indicated that staged diffusers provide the best dilution for receiving waters with strong idirectional currents. (Carroll-FRC)
W82-06420

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,
Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W82-06422

ACCURACY CRITERIA IN DIFFUSION ROUTING,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, and F. D. Theurer.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 747-757, June, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Channel flow, *Flood routing, Muskingum model, Model studies, Routing, *Diffusion model, Hydrographs, Streamflow.

The Muskingum diffusion model, in which the channel routing parameters are calculated based on channel and grid characteristics, is evaluated. Numerical experiments are done to provide information on the criterion for spatial resolution to preserve the accuracy of the method. For very large values of the space step, unrealistic negative flows occur. The numerical experiments show that one of the routing coefficients, C2, should be equal to or greater than 0.33 for most practical applications. The upper limit for the space step can be calculated from an equation which includes the terms Courant length, characteristic reach length, and an accuracy parameter of 2. (Cassar-FRC)
W82-06423

THE V-SHAPED BROAD-CRESTED WEIR,
Waterloopkundig Lab., Delft (Netherlands).
W. Boiten, and R. H. Pitlo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 142-160, June, 1982. 18 Fig, 4 Tab, 15 Ref.

Descriptors: *Weirs, *Discharge measurement, *Crest gages, Hydraulic stuctures, Roughness coefficient, Flow measurement, Discharge coefficient, Flow velocity, Design criteria.

The V-shaped broad-crested weir, a widely used measuring structure in irrigation and hydrologic studies, was investigated to discover the influence of free flow and submerged flow with shape angles of 90, 120, and 150 degrees and to study the thickness of the boundary layer and its effects on the discharge coefficient. A horizontal broad-crested weir was used to study the influence of the crest material. The characteristic discharge coefficient was affected by three inteacting components: boundary layer effects related to crest roughness, lateral contraction upstream and downstream of the critical section Scaling effects may be caused by boundary layer effects if the Reynolds number is less than 300,000. The Froude number in the head measurement section should not exceed 0.2-0.5. The shape angle should not be less than 60 degrees. The modular limit for V-shaped broad-crested weirs is a submergence ratio of 80% if the ratio of the energy head tocrest length does not exceed 0.45. Above this value the modular limit is reduced. Submerged flow can be calculated by introducing a drowned flow reduction factor usable for submergence ratios of 80-93%. The structure is suitable for measuring small and moderate discharges. Rules for design and application are given. (Cassar-FRC)
W82-06450

TURBULENT FRICTION IN A VISCOUS SUBLAYER AND IN THE TRANSITION REGION OF THE FLOW OF WATER IN A FLAT DUCT,
Ye. S. Mikhaylova, and Ye. M. Khabakphasheva.
Fluid Mechanics-Soviet Research, Vol 9, No 6, p 37-51, November/December, 1980. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Turbulent flow, *Flow friction, Hydraulics, *Graphical methods, *Reynolds number, Flow, Flow measurement, Energy, Mathematical studies, Flow characteristics, Hydraulic properties, Flow velocity.

Reynolds stresses have been useful in studying turbulent energy in turbulent wall flow. In the present study, they are utilized in describing measurements in the central part of a flat duct with a

1:10 aspect ration (1 by 10 sq cm). The viscous sublayer and the zone of intensive turbuent energy generation (y(+) < or = 60) in immediate proximity to the wall were examined on a specially developed water loop apparatus. Within the viscous sublayer (y(+) < 5), turbulent shear stresses account for only a few percent of the total friction, whereas at y(+) > 30, viscous friction virtually ceases to have any effect. The effects of fluctuations in u' and v' of various signs and scales on turbulent friction are examined. The role of large fluctuations in turbulent transport of momentum within the viscous sublayer is greater than in the transition layer, where the strips of ordered flow break down at a high rate, while random mixing of the liquid takes place. Results are compared with previously recorded data on the structure of the viscous sublayer. (Geiger-FRC)
W82-06468

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,
For primary bibliographic entry see Field 8A.
W82-06500

SOLUTIONS OF THE COLEBROOK-WHITE FUNCTION FOR RESISTANCE TO UNIFORM TURBULENT FLOW,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
D. I. H. Barr.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 529-535, June, 1981. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Mathematical studies, *Reynolds number, *Turbulent flow, *Hydraulics, *Flow velocity, Mathematical equations, Flow characteristics, Flow, Model studies, Flow friction, Resistance.

For many years, less effective approximations for the Colebrook's smooth turbulent value of the Colebrook-White function approximation for resistance to uniform turbulent flow were widely used. The determination of the diameter when the discharge or the mean velocity is given is examined. Accuracy in approximating the Colebrook-White function requires the application of a correction factor to the smooth turbulent element of the approximation. Except when programmable calculators are applied to the intermittent solution of limited numbers of problems at a time, the conventional approach of iteration to attain a chosen limit of change in value between successive solutions is a wasteful process. A single accurate approximation solution is usually preferred, not only in the simple Colebrook-White function, but in developments for its use. The function may be combined with the Poiseuille equation for continuous laminar-turbulent coverage or used with generalization components to cover transition routes other than those delineated by the simple function. (Geiger-FRC)
W82-06501

NUMERICAL METHODS IN HYDRAULICS,
S. V. Voropaev, and V. M. Lyatkher.
Water Resources, Vol 8, No 3, p 225-226, May/June, 1981. Translated from Vodnye Resursy, No 3, p 32-33, May/June, 1981.

Descriptors: *Symposium, *Hydraulics, *Fluid mechanics, *Numerical analysis, Flow, Heat transfer, Mass transfer, Seepage, Waves, Flow around objects, Model studies, Mathematical models, Hydrodynamics.

The All-Union symposium on numerical methods in hydraulics was held on April 14-18, 1980, in Telavi, Georgian SSR. The symposium's main goal was to compare and analyze the results obtained on solving practical problems of hydraulics by numerical methods. Reports covered the following main subjects: flow around bodies and jet stream; free flows, waves on a water surface; flows in pressure systems; two- and three-dimensional problems of free flows; heat and mass transfer; and seepage. A trend toward the mutual concerns and merger of hydraulics and fluid mechanics was recognized. (Cassar-FRC)
W82-06614

HEREDITARY PHENOMENA IN TURBULENT BOUNDARY LAYERS,
Leningrad Polytechnic Inst. (USSR).
L. G. Loitsyanskii.
Water Resources, Vol 8 No 3 p 241-246, May/June, 1981. 5 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 52-59, May/June, 1981.

Descriptors: *Turbulent flow, *Flow velocity, *Boundary layers, Eddy viscosity, Boussinesq equations, Velocity, Flow characteristics, Numerical analysis, Hydrodynamics, Mathematical models, Model studies.

The Boussinesq formula and its modifications are suitable for use under the conditions of gradual variation of the mean velocity gradient, when the time scale of the variation considerably exceeds the time scale of turbulence. However, these equations do not give satisfactory results when the velocity varies abruptly on a small time scale compared to that of turbulence. Representations which reflect the prior history of the flow are required. This paper examines a general differential equation of transport devoid of local restrictions and a simplification proposed by Hinze and Builtjes, which accounts for the memory effect. Experimental data are compared with results obtained with various equations. (Cassar-FRC)
W82-06618

NUMERICAL METHOD OF SOLVING CERTAIN INVERSE PROBLEMS OF HYDRAULICS,
Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
A. F. Voevodin, and V. S. Nikiforovskaya.
Water Resources, Vol 8, No 3, p 288-292, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 114-118, May/June, 1981.

Descriptors: *Roughness coefficient, *Channel flow, *Flow characteristics, Water level, Unsteady flow, Steady flow, Numerical analysis, Hydraulic properties, Model studies, Mathematical models, Hydrodynamics.

A numerical method for identifying hydraulic parameters (roughness coefficient, coefficient of wind stress, etc.) from data of actual measurements of the level of the free surface or depth of flow is proposed. The flow of water in a channel is described by St. Venant equations. It is assumed that the flow is gradually varied and the identification parameters are constant over the entire length of the investigated reach of the channel. Two sample problems, in which the roughness coefficient is reconstructed, are given. The necessary accuracy in determining the water level is determined by an iterative process. (Cassar-FRC)
W82-06619

TURBULENT TWO-DIMENSIONAL FLOW OF AN INCOMPRESSIBLE FLUID AROUND OBSTACLES WITH SEPARATION,
Central Scientific Research Inst. of Aviation Engine Construction (USSR).
L. V. Gogish, and G. Y. Stepanov.
Water Resources, Vol 8, No 3, p 267-271, May/June, 1981. 3 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 85-90, May/June, 1981.

Descriptors: *Turbulent flow, *Flow around objects, *Flow separation, Numerical analysis, Hydrodynamics, Model studies, Mathematical models, Fluid flow, Hydraulics, Boundary layers, Flow velocity.

The integral method of calculation is the simplest and most reliable method of solving the problem of flow around obstacles with separation at high Reynolds numbers. The method uses empirical information about the general scheme of the flow, quasi-one-dimensional formulations of the problems for region of the layer and wake type, and the usual model of flow of an ideal fluid around a displacement body. Examples of calculating the velocity distribution in the case of turbulent flow around three types of objects (ledge, cylindrical segment projection, and a semicylinder, all located on a plane wall) are given. The complete solution of the problem of flow around an obstacle with separation contains five empirical coefficients. Three are concerned with the local conditions of the boundary-layer separation (increase in pressure, interaction length, and angle of deflection of the displacement body). Two characterize turbulent mixing in the near wake and in the isobaric bottom region. (Cassar-FRC)
W82-06621

INVESTIGATION OF THE TRANSFORMATION OF BREAKTHROUGH WAVES IN THE LOWER POOL OF A HYDROSTATION WITH THE USE OF COMPUTERS,
Georgian Scientific Research Inst. of Power and Hydraulic Structures (USSR).
G. N. Gvazava, L. L. Kvaratskheliya, and I. D. Muzaev.
Water Resources, Vol 8, No 3, p 304-307, May/June, 1981. 3 Fig, 5 Ref. Translated from Vodnye Resursy, No 3, p 135-138, May/June, 1981.

Descriptors: *Dam failure, *Wave propagation, Breakthrough waves, Numerical analysis, Model studies, Mathematical models, Hydraulics, Hydrodynamics, Computers.

The characteristics of the breakthrough waves formed by failure of dams and other water impounding structures were studied with a large-scale model and by numerical analysis. The test station was 1000 m long; channel width, 10-12 to 50-60 m; water volume in the upper pool, 550 cu m; and backwater height, 1.02 m. Two types of experiments were conducted: (1) instantaneous removal of the barrier and (2) blasting followed by breaks and washing away of the dam. The duration of collapse had little effect on the final results of the motion. Maximum depths of the breakthrough wave were the same; in the gradually collapsing situation maximum depths were delayed. Results of the numerical model agreed well with the observed results. Applying the numerical model to a high-head dam showed that collapse of a 100 m dam caused a breakthrough wave propagating at 30-35 m per sec, at which speed the air drag was a significant factor. Subsequently, the model was modified to account for air drag. (Cassar-FRC)
W82-06622

FINITE ELEMENT APPROXIMATIONS TO FLOW PROBLEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mathematics.
G. J. Fix.
Advances in Water Resources, Vol 5, No 1, p 17-20, March, 1982. 3 Fig, 7 Ref.

Descriptors: *Flow, *Finite element method, *Fluid flow, Fluid mechanics, Hydraulics.

Two sample problems using finite element methods to approximate fluid flows are illustrated. The first is a two-dimensional incompressible flow past an obstacle using the stream function and vorticity formulation. An appropriate variational method is developed using the classical Galerkin method. The second example is a three-dimensional incompressible flow using primative variables. The standard Galerkin method is also used, but it can only produce stable and accurate approximations with selected finite element spaces. The two necessary conditions are that the space of pressures must be related to the velocity space by a given equation and that the velocity space must satisfy a decomposition property analogous to the classical decomposition of a vector field into a curl free part and a divergence free part. (Cassar-FRC)
W82-06730

NUMERICAL INVESTIGATIONS OF PLANS OF FLOW IN CHANNELS WITH A COMPLEX BOTTOM RELIEF,

All-Union Designing, Surveying and Surveying and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev, and S. Y. Shkol'nikov.
Water Resources, Vol 8, No 3, p 298-303, May/June, 1981. 3 ig, 9 Ref. Translated from Vodnye Resursy, No 3, p 126-134, May/June, 1981.

Descriptors: *Channel flow, *Flow pattern, *Roughness coefficient, Reservoirs, Flood plains, Numerical analysis, flow characteristics, Flow velocity, Bottom currents, Lower Kama Reservoir, cheboksary Reservoir, *USSR, Model studies, Mathematical models, Hydrodynamics.

Practical problems in channel flow were investigated by numerical modeling using two-dimensional St. Venant equations. Graphic representations of flow in fragments of reservoirs were obtained, allowing the region of interest, such as the inlet section, to be studied without having to calculate flows for the entire reservoir. To substantiate the use of the numerical method, results were compared with results from air pressure model experiments conducted on a 49.3 km reach of the Lower Kama Reservoir. This was partitioned into three fragments. The calculated and experimentally determined velocities agreed well, but the physical experiments detected some eddy regions absent from the calculations. The effects of roughness of the flood plain and channel were investigated for fragments of the Cheboksary Reservoir. In the first study the roughness coefficient of the flood plain was 0.07 and the roughness coefficient of the channel 0-0.07. In this case the channel roughness had little effect on the result; the flows generally followed the direction of the channel. In the second series of experiments the roughness coefficient of the channel was zero and of the flood plain, 0-0.1. For a flood plain roughness coefficient > 0.02 the moduli of the velocity within the channel increased negligibly with increases in roughness coefficient and decreased on the flood plain. Velocity differences were < 0.02, the character of the flow changed markedly and the jet going through reached the flood plain, forming eddies of different spatial scales. (Cassar-FRC)
W82-06785

EXPERIMENTAL INVESTIGATION OF ACCELERATED TRANSITIONAL FLOW IN PIPES,
Tallinn Polytechnic Inst. (USSR).
U. R. Liiv.
Water Resources, Vol 8, No 3, p 307-312, May/June, 1981. 6 Fig, 5 Ref. Translated from Vodyne Resursy, No 3, p 139-145, May/June, 1981.

Descriptors: *Pipe flow, *Transition flow, *Flow characteristics, Unsteady flow, Turbulent flow, Flow velocity, Velocity, Shear stress, Accelerated flow.

The distribution of velocity and intensity of turbulence over the cross section of a flow and the corresponding shear stress values at a pipe wall were studied during the replacement of one steady flow regime by another. The experimental device used a LISA hot wire anemometric apparatus with appropriate detectors for detecting the local characteristics of unsteady turbulent flow. Considerable changes occurred in the flow structure, expresses in deformation of velocity diagrams and in a change in the distribution of the relative intensity of turbulence. Shear occurred within the relative radius of 0.66-0.79, separating the flow into two parts, core and near-wall regions. Although the new level of turbulence was mainly generated in the near-wall region, the final flow characteristics were established more slowly than in the core. The core of the flow was more sensitive to changes in a pressure gradient between ends of the pipe. Eddy stresses were noticeable in the layers between core and near-wall regions during transition flows. (Cassar-FRC)
W82-06786

LOCATING MONITORING WELLS,
Wright-Pierce, Topsham, ME.
B. Caswell.
Water Well Journal, Vol 36, No 5, p 42-43, May, 1982.

Descriptors: *Well hydraulics, *Monitoring, *Path of pollutants, Seepage, Groundwater movement, Vertical flow, Flow velocity, Stratigraphy, Plumes, Geohydrology.

Monitoring wells are used to measure groundwater potentials and obtain water samples for chemical analysis. The hydrogeological factors involved in location of long-term monitoring wells are discussed. Monitoring wells must be located so that they intercept groundwater flowing either into or away from a contaminant source. Long well screens obtain integrated samples, and short screens obtain samples from a specific layer. It may be sufficient to estimate horizontal flow at the site by observation of local topography, but more detailed informaton from observation wells or seismic refraction data may be needed in some cases. Stratigraphy is important. Wells in sand are easy to locate, but wells in granite must be located in specific fractures. Clay layers may interfere with transmission of contaminants; the well screen must be placed in the layer to be monitored. Knowledge of vertical flow patterns is important because contaminants may be moved beneath a too-shallow well in a recharge area, or a too-deep well in a discharge area may intercept only upward moving uncontaminated water. Seepage velocity is important in determining the desirable distance between source and monitoring wells. Dispersion and the geometry of the slug or plume of contamination must also be considered in selecting number location of wells. The density of the contaminant will determine whether the substance will migrate downward and across normal groundwater flow lines. Existing aquifer stresses can alter flow directions and seepage velocities. (Cassar-FRC)
W82-06848

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and W. P. Bartlett, Jr.
Open-File Report 81-350, 1981. 13 p, 17 Feg, 1 Tab, 4 Ref.

Descriptors: *Bridge design, *Hydraulics, *Flood profiles, *Flood flow, Flood recurrence interval, Flood frequency, Flood discharge, Hydrologic data, *Ohio, Chillicothe, Paint Creek.

The Ohio Department of Transportation, Division of Highways, proposes to replace a three-span arch bridge across Paint Creek on South Paint Stree in Chillicothe, Ohio with a new deck-type structure resting on four sets of piles and four piers. Profiles of the 10-, 25-, 50-, and 100-year floods under present conditions and under conditions modified by construction of the new bridge are presented in this report. The results indicate that the construction of the new bridge will not cause significant changes in the flood profiles or the areas inundated. (USGS)
W82-06948

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,
Science and Education Administration, Fort Collins, CO.
R. E. Smith, D. L. Chery, Jr., K. G. Renard, and W. R. Gwinn.
Technical Bulletin No 1655, July, 1982. 70 p, 43 Fig, 3 Tab, 12 Ref, 4 Append.

Descriptors: *Flumes, *Sediment load, *Discharge measurement, Open channel, Flow discharge, Rapid flow, Velocity, Sediment transport, Supercritical flow flume.

High natural velocities and sediment concentrations in many locations prohibit the use of ordinary subcritical flow flumes because these flumes require such low approach velocities that sediment is deposited. Supercritical flumes have been developed to provide flow measurement for conditions of heavy sediment where ordinary flumes do not perform satisfactorily. A general type of supercritical flow flume, called the Walnut Gulch flume, has been developed over many years of experience and testing in discharge measurements at the Walnut Gulch experimental watershed, Tombstone, Arizona. Methods have been developed to analyze flows that exhibit lateral asymmetry in cross sectional profile, and porous dikes have been developed to considerably reduce asymmetry in the alluvial approach section to these flumes. The experience with the Walnut Gulch flumes has led to an improved design of supercritical flume, called the Santa Rita flume. The flume was intended for use in small channel flow measurement, generally less than 4 cu m/s. The slope of the floor breaks at the entrance to the curved approach, and the curvature of the approach wall has been reduced somewhat to decrease the tendency of waves to develop in the throat when flow direction changes too rapidly. (Moore-SRC)
W82-06959

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. I. Vikulova, O. N. Shishova, and E. A. Selivanova.
Water Resources, Vol 8, No 4, p 389-397, July/August, 1981. 6 Fig, 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 4, p 91-102, July/August, 1981.

Descriptors: *Sediment transport, *Canals, *Sand, *Canal embankments, Deformation, Channel erosion, Channel morphology, Erosion, Unstable channels, Bank erosion, Open-channel flow, Channel flow, Flow velocity, Rivers, Dunes, Shoals, Flumes.

Deformation of canals in sand was studied in a 20 x 4 x 1 m flume formed from sand. Several conclusions were reached. Transverse transport of sediment along troughs of underwater sand dunes is an important factor in the channel formation process. The transport of sediment from the banks along the troughs of oblique dunes causes slope instability, eventually widening the channel. Transverse sediment transport within the channel distributes suspended sediment over the entire width of the channel and promotes formation of large bed forms. The two stages of channel development are (1) initial (the channel widens, shoals, loses capacity, and develops transverse dunes, which cause bowing of the flow), and (2) transition (formation of large bed formations as are seen in rivers). The third stage could not be modeled in the laboratory because vegetation is a major factor. The formation of shoals and secondary dunes occurs at constant water discharge. The rate of widening of the channel is dependent on current velocity. (Cassar-FRC)
W82-06990

8C. Hydraulic Machinery

RESONANT WATERHAMMER: A CASE STUDY,
Empresas Publicas, Medellin (Colombia).
H. Perez.
International Water Power and Dam Construction, Vol 34, No 4, p 42-43, April, 1982. 1 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Maintenance, Electric power, Powerplants, Electric power production, Water supply development, Water resources development, Valves, *Waterhammers.

A description is offered of a case of resonant waterhammer on a 270 MW, 550 m gross head project in Colombia. Pressure fluctuation measurements are included and the remedial measures taken to safeguard the installations. The water supply system consists of a 160 meter long tunnel and two penstocks. The total length of the pipes is quite small to cover the height difference between the valve house and the powerplant. Two butterfly valves are provided to control the flow, one at the upstream end of each of the penstocks and six spherical ones at the downstream end, just before the entrance to the scroll case of each of the turbines. The first stage of the project came into operation in 1962. and the second stage in 1965/66. Resonance has occurred on two occasions. After

the phenomenon was studied, it was concluded that typical self-excited resonance had taken place, and that the only element which could have caused the problem was the spherical valve. After a while the conditions for penstock-valve vibration and pressure oscillation of the hydraulic system were tracked down, and the phenomenon could be reproduced at will. Resonance occurred on penstock 1 if the needle valves of units 1 and 2 were open, and a complete shutdown of the system was carried out independently of which one of the units 1 to 6 was taken out of operation. Resonance occurred during a complete outage, though with lower intensity if the needle valves of either 1 or 2 were open. Resonance was noted in penstock 1 and the spherical valve of the unit of which the needle valves were open. No resonance occurred if units 3 to 6 were in operation and units 1 and 2 were stopped, regardless of whether the needle valves of these units were left open or not. (Baker-FRC)
W82-05981

SIMULATING AND IMPROVING HYDRO PLANT CONTROL,
Bochum Univ. (Germany, F.R.). Dept. of Mechanical Engineering.
K. H. Fasol, and M. Hoppe.
International Water Power and Dam Construction, Vol 34, No 5, p 73-78, May, 1982. 6 Fig, 13 Ref.

Descriptors: *Hydroelectric plants, *Control systems, *Simulation analysis, Turbines, Computers, Model studies, Flow regulation.

Analog simulation of a small hydro station with two 40 MW Francis turbines was carried out to provide information on the dynamic performance of the plant. As a result as additional stabilizing compensating circuit was designed, tested by simulation, and then tested in a prototype version. Field tests of frequency response and isolatd network operations confirmed the reliabiity of the simulation. The problem facing this station was the lack of a surge tank within the 6 km long water supply tunnel. Only very small rates of change in the guidevane opening were permitted before instability was reached. (Cassar-FRC)
W82-06202

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),
Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
M. Horster, S. Rabben, and G. Rouve.
Wasserwirtschaft, Vol 72, No 3, p 157-159, 1982. 6 Fig, 3 Ref. English Summary.

Descriptors: *Aeration, *Bottom outlets, *Dams, *High-velocity jets, Floor offsets, Cavitation, Velocity, Energy transfer, Reservoirs, *Gates, *Tunnels, Design criteria, Water pressure, Hydraulic engineering.

Bottom outlet tunnels usually have a very large cross-section due to a small energy gradient drop during operation. The main gate can be placed either at the beginning of the outlet or in the middle of the tunnel. In both cases the gate is the critical transition from pressure to nonpressure flow, where potential energy is transformed into kinetic energy and the question of adequate aeration from above arises. This question can be avoided by placing the gate at the end of the tunnel. The tunnel floor should then be curved in the direction of flow and should be furnished with a connecting offset. In this way, high velocity jets discharging below the gate can be aerated from below as well as naturally from above. Cavitation is also prevented because in the area of the concave curve, pressure forces arise that exceed by far the static pressure. (Gish-FRC).
W82-06242

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN).
Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8B.
W82-06243

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,
North-West Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-06258

DESIGN OF HEAT PUMP RETURN WELLS,
Michigan Dept. of Public Health, Lansing.
D. K. Keech.
Water Well Journal, Vol 36, No 6, p 32-33, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wells, *Design criteria, *Heat pumps, Return wells, Groundwater recharge, Artificial recharge, Recharge, Induced infiltration.

A return well for groundwater heat pumps must be isolated from possible sources of pollution as required by various state or local codes. Construction of the return well should be equal in materials and workmanship to that of a production well and also meet all construction code requirements for the area. In Michigan a clamp-on type of pitless adapter is generally used as the frostproof casing connection to the well. Pressurization of gaskets is a requirement for approval of this design and is important from a public health standpoint on either a production or a return well. Pressurization of the discharge line also has a practical value in preventing water from draining from the drop pipe. It is recommended that 10 psi of pressure be maintained on the line between the heat pump and return well. The back pressure valve must be calibrated to meet the head pressures caused by the static water level for each individual return well. The water level in a return well is elevated in order to apply the higher head that is needed to transmit the water into the aquifer. The specific capacity should be compared to the proposed rate of discharge into the return well. A return well with a specific capacity greater than 1 gpm/ft of drawdown will generally indicate a usable return well, providing the static water level is at a depth of 20 to 25 feet below ground level. One modification which may improve a marginal return well or aid wells with a higher static head is the use of a drawdown seal. (Baker-FRC)
W82-06294

DESIGN CONSIDERATIONS IN WATERWORKS PUMPS SELECTION,
McGraw-Edison Co., N.Y.
W. C. Krutzsch.
In: Water/Engineering and Management, Reference Handbook-1982, p 40-43, May, 1982. 3 Fig, 4 Tab.

Descriptors: *Water treatment facilities, *Pumps, Design criteria, Wastewater facilities, Cavitation.

To ensure the selection of pumps which will provide maximum efficiency, it is necessary to consider specific speed. It has been estblished that the most efficient pumps are those having specific speeds falling in a range of about 2,000 to 2,500. Values below 1,500 are seldom acceptable for networks applications except where the pumps are small and power requirements low. For any given combination of capacity and head, specific speed is directly proportional to pump speed, and higher values of the former can be achieved only by increasing the latter. This situation is unacceptable because the net positive suction head required (NPSHR) of the pump at higher speeds cannot be provided by the system. Pump performance will be unsatisfactory due to cavitation, with resulting noise, vibration, and possibly serious damage to the impeller and to other pump components as well. Recirculation will develop independently at the impeller inlet and outlet as capacity is reduced, most frequently at different capacities for each of these regions. Its cause is inherent in the nature of the centrifugal pump and the uses to which it is put. High specific speed pumps are less suited to waterworks services than optimum specific speed designs. They are most susceptible to recirculation and tend to have more limited operating ranges. The beneficial effects of increased NPSHR on the operating range of a pump can only be realized if the pump manufacturer can take advantage of it. While economic advantages of high specific speed pumps are often publicized, their disadvantages must be noted, and may not become apparent until after installation, making it a costly process. (Baker-FRC)
W82-06343

VARIABLE FREQUENCY DRIVES - SOME APPLICATION PRINCIPLES,
Robicon Corporation, Pittsburgh, PA.
R. N. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 55-56, 58-60, May, 1982. 5 Fig.

Descriptors: *Water treatment facilities, *Design criteria, Energy conservation, Wastewater treatment, Pumps, Hydraulic engineering, Hydraulic design, Hydraulic equipment.

A review of one of the major energy saving potentials typical of the water treatment industry is offered. Use of a variable speed drive can accomplish reduced flow conditions by slowing down the speed of the pump impeller, allowing the motor pump combination to deliver the lower flow at a lower head. With many centrifugal pumps, this means of reduction will require horsepower input proportional to the speed cubed. It is the substitution of variable speed of the prime mover for throttling or bypass of a portion of the pumped fluid to accomplish flow modulation that is the basic idea and will bring about energy savings to the industry. If a system will operate with a control valve to maintain flow at 80% or less for 25% of its operating time, the economies of a variable speed drive for centrifugal machinery should be investigated. If a system is operating with a variable speed drive at 80% flow or less for 50% of its operating time, substitution of a more efficient solid state drive should be investigated. Employment of a variable frequency drive will provide a secondary benefit for the starting of the motor. By using a variable-frequency drive to start the motor, breakdown torque as a limit is available on starting rather than locked-rotor and pull-up torque. This will prove useful to hydraulic engineers confronted with severe limitations of a power system. Other applications include high pressure fans, blowers or compressors used to introduce air to increase oxygen content. (Baker-FRC)
W82-06345

PUMP SUMP DESIGN EXPERIENCE: SUMMARY,
Engineering Hydraulics, Inc., Longmont, CO.
C. E. Sweeney, R. A. Elder, and D. Hay.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 361-377, March, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Design criteria, *Sumps, *Pumps, Hydraulic models, Performance evaluation, Flow characteristics, Hydraulic machinery, Cooling water, Vibration, Model studies.

The capacity of vertical mixed flow pumps used to provide cooling water for industrial purposes and power generation has been increasing in recent years. However, since the thickness of the casing wall and the rigidity of the support do not increase in the same proportion as the hydrodynamic loading on the pump, larger pumps are more susceptible to vibration and rough running and better entrance flow conditions are needed to ensure satisfactory performance. The conditions of flow entering a pump are the net result of approach flow to, and the hydraulic design of, the sump in which the pump is operated. Hydraulic conditions which may result in pump performance problems, standards currently used in sump design, and criteria used to judge the acceptability of sump designs on the basis of the performance of hydraulic models are discussed. The designs of seven wet well sumps

for vertical mixed flow pumps modified through hydraulic mode tests are presented and compared with design standards currently in use. Although currently published standards for basic sump dimensions provide a good starting point, modifications are needed to achieve satisfactory hydraulic performance by large pumps. Performance criteria used in the development of the existing standards may not have been as stringent as those required for current large capacity pumps. A variety of suggestions for sump modifications and dimensions are presented which may provide a basis for developing conceptual or trial designs for sumps for large capacity pumps. A hydraulic model study should be performed when designing any major pumping facility to assure satisfactory performance. (Carroll-FRC)
W82-06419

SWIFT ACTION BY STATE OFFICIALS PREPARES FOR WATER SUPPLY CRISIS.
Public Works, Vol 113, No 3, p 64-65, March, 1982.

Descriptors: *Water transfer, *Water supply, *Pumping plants, New York, New Jersey, Drought, Pipelines, Water shortage.

New Jersey installed a 20 mgd temporary, portable 24 inch water main across the George Washington Bridge, to supply water to the drought-stricken northeast section of the state in 1981. The source of the water was the upper Delaware River, from which New Jersey had not previously used its full allotment. A permanent pumping station was built in an unused tunnel at 179th and Amsterdam Avenue, New York. Suitable pumps, which normally require months to fabricate, were diverted from shipment to a petroleum company in the Southwest. The pump and pipeline system is available for use in water emergencies and can be dismantled and stored in years of adequate rainfall. (Cassar-FRC)
W82-06514

ZIMBABWEAN HAND PUMP PASSES VILLAGE-LEVEL ENDURANCE TESTS.
Water Water, Vol 5, No 5, p 36-37, May, 1982.

Descriptors: *Pumps, *Developing countries, Rural areas, Wells, Water supply, *Zimbabwe.

The low cost, rugged Blair/Prodorite hand water pump, developed in Zimbabwe, appears to fulfill the criteria for a village level operation and maintenance pump. Costing $75 in kit form, the pump is made of lightweight plastic. Only the galvanized iron pump handle, which doubles as the water spout, is visible above ground. Below ground the pump consists of two plastic cylinders, one inside the other, fitted with identical valves at the base. The inner pipe is the piston/push rod. The upstroke draws water into the cylinder through the lower fixed foot valve. The downstroke closes the foot valve and forces water up the hollow portion to the surface. The pump is usable to depths up to 15 m. It lifts 20 liters per min, and 30-40 strokes by a young person can fill a bucket. Installation requires only the simplest tools and little technical expertise. Maintenance is confined to occasional clearing of debris from the foot value. In a factory test the pump was continuously pumped for 6 million strokes (90 years of use for a single family) with no detectable wear. (Cassar-FRC)
W82-06606

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),
H. Brombach.
Wasserwirtschaft, Vol 72, No 2, p 44-52, February, 1982. 6 Fig, 1 Tab, 17 Ref. English Summary.

Descriptors: *Control systems, *Storm-overflow sewers, *Storm wastewater, *Hydraulic equipment, Wastewater facilities, Wastewater treatment, Valves, Flow control, Flow characteristics, Hydraulic engineering, Decision making, Planning, West Germany.

Various controllers for stormwater treatment plants are discussed in terms of performance and suitability for different types of facility. Pipe throttles are the most common type of controller in the West German sewage system, though they are not easily adapted to differences in quality and quantity of flow. The throttle slide valve is suitable for stormwater overflows and purification basins due to its low height and space requirements, large discharge, and subquadratic discharge pattern. Vortex throttles can significantly undercut the minimum discharge of the pipe throttle and are especially useful for small stormwater basins. The automatic vortex valve has roughly the same discharge span as the vortex throttle but is safer during operation; it is suited to storm overflow basins because it switches on less often and later than other controllers and produces its own short flushing surges. The float flap with nonlinear kinematics is well suited to stormwater overflow basins and flood protection basins, while the closed-loop controller (a hybrid using both electromechanical and hydraulic energy) is employed exclusively in exposed stormwater basins. The stop-and-go controller is used for stormwater basins with outflow of < 10 l/sec, because continuous control provides too small a sweeping force and too great a risk of blockage. A complex diagram to aid in the choice of a controller is presented, as is a method for installing a cortex valve. A five-step plan for controller strategy for a serial system of overflow basins is described. Transition to automatic systems is presented in the form of a three-stage plan. (Gish-FRC)
W82-06633

PUT PRESSURE ON SEWAGE,
Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 5D.
W82-06732

8D. Soil Mechanics

THE VALUE OF INSPECTION GALLERIES,
Lahmeyer International G.m.b.H., Frankfurt am main (Germany, F. R.).
C. Kutzner.
International Water Power and Dam Construction, Vol 34, No 5, p 78-84, May, 1982. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Inspection galleries, *Dam design, *Seepage control, Earth dams, Rockfill dams, Grouting, Drainage systems, Dam foundations, Foundation rocks.

Inspection galleries, also known as grouting galleries, inspection tunnels, drainage galleries, or control galleries, are often built inside or below dams. This paper discusses the advantages of inspection galleries in earth and rockfill dams. Seepage monitoring and control can be readily accomplished by piezometers installed in the inspection gallery. Release holes for preventing or reducing uplift below the downstream dam body can be readily drilled from the gallery. Underground settlement and displacements can be monitored from the gallery. Grouting work can be performed from the gallery without disturbing the embankment filling process. If necessary, grouting can also be done after impoundment. The negative aspects of galleries include extra costs and the possibility of disturbing foundation rock. Design and construction details for inspection galleries are given. (Cassar-FRC)
W82-06204

THE GROSSE DHUNN DAM AND THE FACILITIES FOR THE CONTROL OF STABILITY AND FUNCTIONING (DIE GROSSE DHUNNTALSPERRE UND DIE MESSEINRICHTUNGEN ZUR UBERWACHUNG DER STANDSICHERHEIT UND DER FUNKTIONSTUCHTIGKEIT DES DAMMES),
Talsperrenabteilung des Wupperverbandes (Germany, F. R.).
F. Cords.
Wasserwirtschaft, Vol 72, No 3, p 119-123, 1982. 9 Fig, 1 Tab, 2 Ref. English Summary.

Descriptors: *Dams, *Measuring instruments, *Rockfill dams, *Dam construction, Hydraulic engineering, Drinking water, Reservoirs, Water resources development, Water supply, Soil mechanics, Seepage, Safety, *West Germany, Grosse Dhunn Dam.

The Wupperverband constructed the Grosse Dhunn Dam 10 km east of Leverkusen, West Germany, to ensure an adequate drinking water supply for the Bergisches Land to the year 2000 and beyond. This is a rockfill dam (built 1979-1980) with bituminous core sealing and a grout curtain (finished in 1981) with double rows to 25 m and single row to 50 m under foundation level. The dam is 63 m high, 380 m long, and 8.5 m wide. Its capacity is 81 cu hm. The planning, subsurface exploration, construction, and installation of measurement and control equipment is described. The rockfill-type dam was chosen as esthetically pleasing in the given landscape. Soil mechanics studies resulted in the bituminous core being bent toward the air side in the upper third and in the division of the dam cross-section into core zones with fill of small rocks and outer zones where less sealing was required. Particular care was taken to perform quality control on the bituminous core, as after installation this can no longer be inspected. Numerous measurement points were installed to observe all movement and sealing properties of the dam during and after construction. External deformations could be detected by above-ground measurement points at five dam cross-sections, while internal deformations could be measured on the air side by a shaft lying along the third above-ground cross-section. Techniques applied were leveling, angle measurement, electrooptical distance measurement and optical sounding in the shaft. Tension measurement was also performed. To control the sealing properties, the transition zone on the air side of the bituminous core was constructed of coarse ballast without fill to allow for seepage. (Gish-FRC)
W82-06240

TEST AND CONTROL PROGRAMME FOR TWISTE DAM SITUATED IN SANDSTONE AND WITH RESTRICTED EXTENT OF SUBSURFACE SEALING (MESS- UND UBERWACHUNGSPROGRAMM EINER STAUANLAGE IM BUNTSANDSTEIN BEI BEGRENZTER UNTERGRUNDABDICHTUNG AM BEISPIEL DER TWISTETALSPERRE),
G. Bjornsen.
Wasserwirtschaft, Vol 72, No 3, p 135-139, February, 1982. 6 Fig, 4 Ref. English Summary.

Descriptors: *Dam design, Geology, *Sandstones, *Soil mechanics, *Rockfill dams, *Groundwater movement, *Sealing, Safety, Design criteria, Dam construction, Dams, Hydraulic engineering, Twiste Dam, *West Germany, Seepage, Permeability, Drainage, Testing procedures.

Geological conditions at the site of the Twiste Dam, West Germany, are unfavorable. The dam is situated in new red sandstone, and the valley gravel and sides and the underlying rock are permeable. Groundwater streams are forced to change direction around the dam shoulders and into a neighboring valley. The dam itself is permeable, as it is filled with new red sandstone, but water pressure is reduced by the carpet of river clay on the valley floor and by weathered rock on its sides. Soil mechanics and projections of groundwater flow under and around the dam by means of potential theory determined the dam design. The fill was compressed in layers to reduce permeability, and a trench-furrows drainage system was built on the air side embankment to lessen possible negative effects of compression on the surface filter. Because of the soft plastic clay foundation, the dam was built very wide with a flat embankment; to improve the watertightness of the clay, additional clay sealing and compression of the basin floor were performed. Reduction of water flow around the dam was achieved by extension of the injection curtain about 20 m beyond the shoulder. A five-year test program, during which the dam was filled to capacity in stages, confirmed the theoretical model and led to the introduction of additional

safety measures. For example, meadows below the dam became waterlogged and a drainage system was constructed; seepage into the neighboring valley necessitated an extension of the valley-side sealing to the height of greatest operating capacity. The program demonstrated the importance of separate geohydraulic systems: on the one hand, bank prefilling, valley-side permeability and trench-furrowed drains; on the other, basin sealing, rock foundation, dam, and surface drains. The influence of anisotropy should be taken into account at the planning stage. (Gish-FRC)
W82-06632

8E. Rock Mechanics and Geology

INVESTIGATIONS FOR NORWAY'S LONGEST UNLINED PRESSURE SHAFT,
Geoteam A/S, Oslo (Norway).
J. Bergh-Christensen, and R. Kjelberg.
International Water Power and Dam Construction, Vol 34, No 4, p 31-35, April, 1982. 9 Fig, 2 Tab, 3 Ref.

Descriptors: *Excavation, Water resources development, *Norway, Construction, Stability, Mathematical studies, Computers, Model studies, Design criteria, Geological surveys, Tunnels.

An unlined pressure shaft is described which will sustain the highest water pressure in Norway, and probably in the world. The geology of the site is described, along with studies undertaken to determine the design criteria. The pressure shaft is 1130 meters long, with a static head of about 1000 m. The topography of the sites is complex, and the main part of the scheme is at an evaluation varying between 1000 and 1200 meters, where the terrain is mountainous and rugged. From the reservoir the water is fed through a headrace tunnel to the top of the pressure shaft at an altitude of 800 meters. The pressure shaft itself will have an inclination of 45 degrees, with its lower end just inside the powerplant. The method used for evaluation of the shaft siting is based on a calculation of total stresses by finite element plain strain analysis. The main condition imposed by this approach is that the minimum total stress should be higher than the water pressure at every point along the shaft, to avoid the risk of failure by hydraulic fracturing. The computer program used gives, for this type of finite-element analysis, the stress distribution along a vertical plane normal to the contour lines of the terrain model. The shaft has to be located, in this case, obliquely in relation to the valley side, and consequently the standard program does not give the complete stress distribution along the shaft in a single run. The results of the model studies indicated that the maximum total stress was mainly parallel to the valley side. The preliminary location of the shaft should be sufficiently safe, from these studies, and this location was chosen for the final site. (Baker-FRC)
W82-05980

DESIGNING AND EXCAVATING UNDERGROUND POWERPLANTS,
Trondheim Univ. (Norway). Dept. of Geology.
E. Broch.
International Water Power and Dam Construction, Vol 34, No 4, p 19-25, April, 1982. 8 Fig, 8 Ref.

Descriptors: *Powerplants, *Design criteria, Construction, Tunnels, *Underground structures, Stability analysis, *Norway, Geologic fractures, Geology.

Norwegian experience in the field of underground powerhouses is reported, noting that about half the world's underground stations are located in that country. Until recently the conventional drill and blast technique has been the dominating method of excavation. Approximately two thirds of the country consists of Precambrian rocks, with different types of gneisses dominating. Other major rock types from this era include granites, gebbros and quartzites. There are also provinces dominated by arkosic sandstones and shales. Norwegian bedrock is very old and, from an engineering geological point of view, one could describe it as a typical hard-rock province. With knowledge of geological conditions, a geological engineer may give advice so that construction problems for an underground opening in rock may be avoided or solved in an economical way. Geological conditions include the types of rocks and the mechanical properties of each, the jointing of the rock masses, the weakness zones of the bedrock, stress conditions in the rock masses and the water conditions in the rock masses. The most important part of a feasibility study for an underground opening is to find the right place and position. Certain unfavorable types of rock should be avoided. Soapstones, serpentinites and periodotites together with jointed tectonites with clay coated joints and fissures have caused severe stability problems in underground openings. Considerations for the orientation of the long axis of the powerhouse, shaping of underground openings, dimensioning of underground openings, and design considerations for unlined shafts and tunnels are discussed. (Baker-FRC)
W82-05982

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),
H. Breth.
Wasserwirtschaft, Vol 72, No 3, p 152-157, 1982. 15 Fig. English Summary.

Descriptors: *Powerplants, *Weirs, *Subsoil, *Erosion, Hydroelectric plants, Erosion control, Geologic mapping, Geologic formations, Sealants, Silt, Dams, Water resources development, Filters, Screens, Drau River, *Austria, Control systems, Seepage control, Design criteria, Hydraulic engineering.

The power station Annabrucke and the accompanying weir were constructed on the River Drau in Austria on a subsoil endangered by erosion. The subsoil is composed of very permeable river gravel under which a layer of semi-permeable silt of varying thickness is found; within the latter, sands and occasional pockets of gravel occur caused by the steep angle of these strata. Under the main barrage and turbine and weir outlets lies the largest pocket of gravel containing dangerous inlays of uniform-sized grains. In order to use the silt layer as a sealing element, the power station and weir, as well as the two dams adjoining them on either side were joined to the silt layer by a sealing screen. The braking effect of the silt meant that seepage water would flow through the three-level surface filter behind the main structure into the bottom water almost without pressure. A further louvered slide was built behind the surface filter to cut of the uniform grain layers and force groundwater through the filter. An electrical analogy model confirmed the sealing and braking concept. The decision to build a power-station complex on such a foundation requires extensive site investigation using numerous bores to construct a model as well as a thorough observation system so that runoff can be controlled not only under the main structure but also under the basin and dams bordering the basin, behind the dams and in the bottom water under the main structure. A year after operation began, measurements showed that the braking effect of the silt and the draining effect of the uniform-grain layers ensured that seepage was dissipated before it reached the turbine and weir outlets so that the danger of erosion in the susceptible layers was eliminated. (Gish-FRC)
W82-06636

INVESTIGATION OF THE PARAMETERS OF WAVES ON A RESERVOIR SURFACE IN THE EPICENTRAL ZONE OF AN EARTHQUAKE,
Akademiya Nauk URSR, Kiev. Inst. of Hydromechanics.
B. N. Ostroverkh.
Water Resources, Vol 8, No 3, p 282-288, May/June, 1981. 4 Fig, 4 Ref. Translated for Vodnye Resursy, No 3, p 105-113, May/June, 1981.

Descriptors: *Reserviours, *Earthquakes, *Wave propagation, *Oscillatory waves, Mthematical models, Seismic waves, Model studies, Numerical analysis, Wave height, Rock mechanics.

The effect of earth quake zone parameters on surface waves in reservoirs was investigated using a numerical model to vary depth of the zone, rate of dislocation diffusion, remoteness from the epicenter, and the direction of tangent stresses along the displacement walls of the fissure. Figures showed the value of the maximum displacement of the water (the wave height) as a finction of: (1) the distance of the earthquake focus and (2) the depth of focus. Modeling results indicated that consideration of the combined oscillations of the elastic region and fluid region had a negligible effect on the oscillations of the elastic region, i.e., the oscillations of the surface of the wet and dry bottom were not significantly different from one another. However, it was necessary to consider the residual deformations of the bottom, formed in the case of a shallow-focus earthquake.(Cassar-FRC)
W82-06783

8F. Concrete

WORLD'S FIRST ALL-ROLLCRETE DAM,
Army Engineer District, Walla Walla, WA. North Pacific Div.
E. K. Schrader.
Civil Engineering (New York), Vol 52, No 4, p 45-48, April, 1982. 2 Fig.

Descriptors: *Dams, *Construction materials, Construction, Design criteria, Water resources development, Water supply, *Concrete, Oregon.

The use of roller-compacted concrete was explored in the construction of a 400,000 cubic yard of concrete by more than two-thirds. Willow Creek Dam will be the world's first gravity dam to be built entirely with roller compacted concrete. Other such dams are now under construction. By using this method, Willow Creek Dam will be built with 75% less material than was required for the originally designed rockfill structure. The dam will be built in about one year instead of the three years previously planned. The spectacular savings in both time and money are due to the lower cement content required and the substitution of efficient earthmoving equipment and techniques for the far more labor intensive bucket-by-bucket procedure for placing conventional concrete. One of the main advantages of the design at Willow Creek was the elimination of a separate side channel spillway otherwise required for a rockfil or embankment dam. (Baker-FRC)
W82-05999

MIX DESIGN PARAMETERS FOR CONCRETE CONTAINING CHEMICAL ADMIXTURES,
E. L. Ore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237082, Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-81-6, December 1981. 27 p, 12 Fig, 5 Tab. 0-07-DV-00109.

Descriptors: *Concrete additives, *Concrete technology, *Concrete mixes, Compressive strength, Cements, Temperature effects, Aging, Setting time, Water-cement ratio.

Concrete samples having water to cement ratios ranging from 0.35 to 0.65 with various quantities of WRA (water-reducing and set-controlling admixtures) ranging from 0.00 to 0.40% at three temperatures were prepared and periodically tested at intervals up to 1 year. An average quality aggregate was used to provide adequately conservative concrete design data. The effect was evaluated for each condition of WRA on the rate of hardening at early ages, as shown by the resistance to penetrate of the wet-screened mortar, and at extended aging, as shown by the compressive strength. The larger dosages of WRA generally resulted in lower water requirements; however concrete with 0.10% WRA required slightly more water than the reference

concrete. From 21 to 32 C, the water requirement increased 4.5% for each 5.5 degree temperature change. The setting time of mortar, wet-screened from concrete, increased as the WRA dosage increased. Larger amounts of WRA resulted in 1-day compressive strengths which were lower than the reference concrete, but by 3 days all concrete samples with WRA were stronger than the reference concrete. All concretes containing WRA were stronger than those without WRA except for the 0.40% WRA concrete where the 1-day strengths were slightly less. The use of WRA's was most effective in concrete with lower water-cement ratios and higher temperatures. A comparison of concretes with equal 28-day strengths but different water-cement ratios showed that the concrete without WRA was stronger at 90 days and 1 year than that with WRA. (Moore-SRC)
W82-06397

WATER TANKS IN REINFORCED CONCRETE,
Norwest Holst Construction Ltd., Watford (Englandd).
W. M. Pedder.
Water Services, Vol 86, No 1033, p 117-119, March, 1982. 2 Fig, 1 Tab.

Descriptors: *Concrete construction, *Water tanks, Reinforced concrete, Water storage, Design criteria, Joints.

Reinforced concrete water storage tanks are commonly constructed in pairs, buried and landscaped for esthetic reasons. A typical design is 2 tanks each 25 m square, 4.5 m deep. Each tank roof is covered with gravel for grainage and soil for a grass cover. Expansion joints are not usually required up to about 70 m length. Columns to support the roof are conveniently spaced on a 4.8 m square grid. All vertical wall joints, except corners, and internal movement joints should be full contraction joints. Roof joints are partial contraction joints. Metal or polyvinyl chloride water bars and sealant are usually provided at all joints. Details for design of walls and roof slabs are given. (Cassar-FRC)
W82-06604

8G. Materials

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,
Massachusetts Univ., Amherst. Dept of Chemistry.
For primary bibliographic entry see Field 5F.
W82-06051

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,
Mobil Oil A.G., Celle (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W82-06120

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMI-DICHTUNGEN),
By H. Steffen.
Wasserwirtschaft, Vol 72, No 3, p 144-147, 1982. 3 Fig, 3 Ref. English Summary.

Descriptors: *Sealants, *Dams, *Errors, *Design criteria, Core seals, Surface seals, Materials, Hydraulic engineering, Stress, Seepage, Erosion, Construction, Stress, Construction joints, Expansion.

The installation of sealing in dams is discussed with emphasis on the interaction between the sealing and transition materials, foundation and support structures. For surface sealing, the foundation should be laid so that as little movement as possible occurs through consolidation, or transition materials should be chosen that allow the sealing to move in the direction of the expected stress. Copper is preferable to plastic where the transition material must carry high water pressure. Common errors are failure to place an expansion joint in the area where movement is expected or a too-massive construction of the transition joint. Plastic materials are more susceptible to erosion. Core sealing may experience fission forces if distortions occur in the supporting structure; these may lead to seepage and erosion. Distortion of the core is another cause of damage. For asphalt cores, transition zones are recommended. Quality control of the sealing during and after installation is important: for core sealing, an area may be singled out as a test zone, and test cores should be extracted from the main core; the success of surface sealing can be determined by isotope sounding. Four examples of sealing errors are given: a too-porous material was used in the first-ever bituminous core seal, and led to permeability; in an asphalt membrane seal a tear above the joint led to slippage of the shear stress of the seal away from the joint, which caused a tear; a too-large joint in an asphalt seal caused a lack of give with expansion stress and let to the seal separating from the dam; and a tear occurred between strips of plastic sealing, allowing water to flow into the dam. None of these failures presented a danger to dam security, due to well-planned design and inspection measures. (Gish-FRC)
W82-06241

SEWERAGE: PRIORITIES FOR ACTION,
Water Research Center (England).
D. Fiddes, and M. J. Rouse.
Water Pollution Control, Vol 81, No 2, p 280-287, 1982. 12 Ref.

Descriptors: *Sewer systems, *Rehabilitation, Maintenance, Structural engineering, Physical properties, Construction materials, Hydraulic profiles.

This paper considers both the structural and hydraulic problems involved in planning proper sewage transport and treatment and suggests priorities for action by the industry. Evidence for the scale of sewer dereliction in the United Kingdom is collected from two sources: collapse and sample surveys. Data collection has been a major problem, as historic data were scarce. A collapse is defined as any sewer failure where excavation is required to effect the repair. The UK collapse rate appears to be about 5000 incidents per year. The current collapse rate would suggest a mean service life for the current sewer population of about 1000 years. Evidence from closed circuit television surveys shows that after reaching about 70 years of age, brick sewers deteriorate rapidly. The amount of money spent annually to rehabilitate sewers in rsponse to collapse incidents roughly equates to the estimated expenditures on all sewerage rehabilitation. It may therefore be concluded that very little planned renewal is being undertaken. Work is currently underway to divide the existing sewer system into three zones - Zone A will contain the dewers where rapid detrioration has a high probability, Zone B will have less frequent surveys and only gross defects will be dealt with, and zone C will have maintenance only in response to incidents. Assessment of the hydraulic performance of sewerage systems is even more difficult. The lack of analysis techniques and the known presence of many unrecorded storm overflows together with the transient and infrequent occurrence of flood-producing rainfall make it inevitable that many of the older sewer systems are also performing indifferently in the hydraulic sense. (Baker-FRC)
W82-06260

ADVANCED COATINGS FOR THE WATER INDUSTRY.
Water Services, Vol 86, No 1033, p 124-125, March, 1982.

Descriptors: *Coatings, *Corrosion control, *Water tanks, Waterproofing, Plastics.

Several protective coatings for use in the water industry are described. They waterproof but are generally vapor permeable. Decadex, for external tank use, is solar reflective. It protects stone, brick, concrete, slate, wood, and tile from water, weather, and most chemicals by a seamless application. Steridex, a fungistatic protective finish, is used in drinking water plants. Sterepel not only is fungistatic, it also kills insects and rodents. Firecheck is a flameproof coating. Isoclad protects metal structures from rust and salt spray attack. Soladex is an elastomeric solvent-based high-build barrier coating which protects a wide range of substrates from water penetration and corrosion. It is ideal for use in low temperature areas. These products are manufactured by Liquid Plastics Limited, Preston, England. (Cassar-FRC)
W82-06603

CROSS-COUNTRY FORCE MAIN.
Water/Engineerig and Management, Vol 129, No 7, p 47-48, June, 1982.

Descriptors: *Pipelines, *Wastewater disposal, *Plastics, Force mains, Hortonville, *Wisconsin, Polyethylene.

A $370,000 12 inch diameter high density polyethylene force main buried 7-9.5 ft deep carries wastewater effluent from the Hortonville, Wisconsin, treatment plant to the river 2.5 miles away. The route was chosen to bypass the town and reduce costs of digging up streets. A wildlife marsh was located only 50 ft from the plant, but effluent discharge there was not allowed without expensive tertiary treatment. Pipe sections were joined by heat fusion to form an essentially continuous conveyance, except for planned air release and access points. The flexible pipe is expected to perform well in the shifting, corrosive soil. (Cassar-FRC)
W82-06640

STATUS OF POROUS PAVEMENT RESEARCH,
Municipal Environmental Research Lab., Edison, NJ.
R. Field, H. Masters, and M. Singer.
Water Research, Vol 16, No 6, p 849-858, June, 1982. 11 Fig, 1 Tab, 8 Ref.

Descriptors: *Paving, *Porosity, *Infiltration, Storm runoff, Water pollution sources, Aquifer recharge, Flood control, Water pollution control.

The Porous Pavement Research Program of the Environmental Protection Agency is discussed, including information on the economics, advantages, potential applications, and status and future research needs of porous pavements. Such pavements are an available stormwater management technique which can be used on parking lots and low volume roadways to reduce both stormwater runoff volume and pollution. In addition, groundwater recharge is enhanced. Also, cost reductions result due to elimination of curbs, drains, and small sized storm sewers. Porous asphalt pavements consist of a relatively thin course of open graded asphalt mix over a deep base of large size crushed stones. Water can be stored in the crushed stone base until it can percolate into the subbase or drain laterally. Other porous pavement types include concrete lattice blocks and a porous concrete mix. If the possibility exists that water infiltrating the ground could reach a water supply aquifer, adequate protective means should be undertaken to determine that the surface runoff is not still contaminated when it reaches the aquifer. (Baker-FRC)
W82-06665

8H. Rapid Excavation

PRACTICAL CALCULATIONS AND RECOMMENDATIONS ON THE USE OF GUNPOWDER ROCK BREAKERS IN HYDROTECHNICAL CONSTRUCTION,
N. Ya. Orlov.
Hydrotechnical Construction, Vol 15, No 8, p 502-506, 1981. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stov, No 8, p 51-53, August, 1981.

Descriptors: *Rock excavation, *Hydraulic equipment, *Hydraulic properties, *Mathematical analysis, *Hydraulic engineering, Hydraulic design,

Equations, Hydraulic geometry, Rock properties, Strength, Explosives, Gundpower Rock Breakers.

The effectiveness of gunpowder rock breakers in fracturing old foundations and structures depends largely on the parameters of the hydraulic pulse. Fracture of the medium is possible where the maximum pressure in the pulse is > or = to the compressive strength strength of the medium. Equations are given to analyze the water-hammer phenomenon that occurs in the compressive phase of the pulse and determines the processes of dynamic compression of the fluid with interference of the shock waves and without outflow of the fluid into cracks. These take into account the design of the rock breaker, the geometry of the shothole, and the physical properties of the medium. They show that the elastic volume in the area of the anchor device greatly affects the reflection of the incident waves and slows the pressure increase in the pulse. The half-phases of the annular section and of the perforated part of the tube are important in attaining maximum pulse amplitude, and the inertia of the annular section is influential in shaping the pulse. Equations for measuring cracks occurring at the end of the compression phase and for determining the duration of the discharge phase are also given. Finally, calculations are given for fracturing a mass by means of several rock breakers acting simultaneously. (Gish-FRC)
W82-06086

8I. Fisheries Engineering

NOTES ON THE CONSTRUCTION, INSTALLATION AND ENVIRONMENTAL EFFECTS OF HABITAT IMPROVEMENT STRUCTURES IN A SMALL LOWLAND RIVER IN SHROPSHIRE,
Liverpool Univ. (England). Dept. of Zoology.
S. Swales.
Fisheries Management, Vol 13, No 1, p 1-10, 1982. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Aquatic habitats, *Dams, *Deflection, *Fish management, Water depth, Habitats, Perry River, England, Turbulent flow, Channel improvement, Riffles, Flow velocity, Water currents.

Fish Habitat improvement structures were placed in the River Perry, a small lowland river in England, The channel had been dredged and widened on several occasions since 1900 to improve drainage conditions. In a 600 m reach two low dams (< 1 m high) and two current deflectors were installed. One deflector was put in a shallow fast-flowing area and the other in a deeper slow-flowing section. A floating plywood artificial cover was added to simulate overhanging bank vegetation and undercut banks. The dams increased water depth and reduced current velocity above the impoundment and decreased water depth and increased current velocity (maximum 80 cm per sec) downstream. Below the dams the greatly increased water turbulence scoured bed material, producing a pool and ripple pattern. Both current deflectors increased flow velocity (maximum 60 cm per sec) by narrowing the river channel, but only the one installed in the shallower, fast-flowing part of the river produced a pool-ripple pattern. The temporary covers effectively simulated natural cover but were damaged by winter floods. (Cassar-FRC)
W82-06084

HYDROACOUSTIC ASSESSMENT OF PELAGIC FISH STOCKS: A POTENTIAL NEW MANAGEMENT TOOL,
Vermont Univ., Burlington.
G. W. LaBar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256660, Price codes: AXX in paper copy, A01 in microfiche. Report, February, 1981. 35 p, 23 Fig, 4 Tab, 2 Ref. OWRT A-037-VT(1).

Descriptors: *Sonar, *Sound waves, *Fish populations, *Remote sensing, *Trawling, Fathometers, Sounding, Water depth, Aquatic populations, Populations, Aquatic life, Fisheries, Marine environment, Technology, Commercial fishing, Fish harvest, Aquatic animals, Fish, Smelt, Biomass, Aquatic productivity, Fish management, Acoustics.

Hydroacoustic assessment, a tool for employing sonar to assess fish area populations in fisheries and the marine environment, is receiving increased attention. Studies were carried out to develop a method of analyzing echograms employing echo density and variability concepts, to compare mean echo densities on echograms with catches from a midwater trawl and to compare echograms from various Lake Champlain sites at various time periods. Specifically, a dot-grid was used for analysis of echo density on the echograms in an attempt to determine relative abundance of pelagic fish. Highest echo-densities were generally noted between 60-100 feet. While significant echo count differences were found between depths, between Lake sites, and between times, no real pattern of echo count differences emerged. Correlation coefficients relating midwater trawl smelt catch numbers to mean echo counts at trawling depth were -0.02 for large (45 ft square mouth) and 0.37 for small (16 ft square mouth) trawls. However, the relationship between echo counts and biomass is unknown. While a combination of echo sounding needed before other standard assessment techniques can be eliminated. The method developed herein, however, has been demonstrated to Vermont fish and game personnel. (Zielinski-MAXIMA)
W82-06373

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
F. B. Lotspeich, and F. H. Everest.
Forest Service Research Note PNW-369, January 1981. 11 p, 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Gravel, *Spawning gravel, Streambeds, *Sediment sampler, *Aquatic habitats, Larval growth stage, Permeability, Pore size.

Textural composition of spawning gravel influences survival and emergence of salmonid embryos. A new method has been developed for collecting, sorting, and interpreting gravel quality. Because both sediment distribution and redd site selection by salmonids are nonrandom events, the location from which samples are drawn should be identified by an experienced fishery biologist. Samples are collected with a tri-tube freeze-core device and dry-sorted using sieves based on the Wentworth scale. An index to the quality of gravel is obtained by dividing geometric mean particle size by the sorting coefficient (a measure of the distribution of grain sizes) of a sample. The resulting number is called the 'fredle index' and is proposed as a standard for evaluating the reproductive potential of spawning gravel. The magnitude of fredle numbers is a measure of both pore size and relative permeability, both of which increase as the index number becomes larger. Permeability and pore size control movement of water and alevins through gravel. This method of calculating a quality index for stream sediments allows identification of the quality of gravel used for reproduction by salmonids. Comparisons can be made of gravel quality within and between strams, and temporal changes in texture and permeability can be monitored. The technique should be especially useful for measuring changes in gravel quality resulting from sedimentation from nonpoint sources in managed forest watersheds. (Moore-SRC)
W82-06395

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 7B.
W82-06703

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-06985

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH SUPPORT PROGRAM 1981 - 1982.
Department of the Environment, Ottawa (Ontario).
1981. 12p, English and French.

Descriptors: Water resources, *Research projects, Inland waters, Universities, Quality, Pollutants, Modelling, Contamination, Hydraulics, Data collections, *Canada.

The Department of the Environment, on the recommendation of the Water Resources Research Support Program Review Group, has agreed to provide a total of $250,000 for water-related environmental research during 1981-81 to the Canadian university research community. The Water Resources Research Support Program provides for innovative research relevant to departmental concerns and responsibilities for water resources research in the natural and social sciences with emphasis on water management issues. By fostering the interest of university researchers, it thereby utilizes their knowledge and expertise in solving water research problems and provides opportunities for their participation in socially relevant environmental research. Fifteen universities across Canada will share the $250,000, which will be used to support both unidisciplinary research projects and multi- or interdisciplinary programs aimed at solving regional and national water research issues. (WATDOC)
W82-06565

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

FRESHWATER MACROINVERTEBRATES,
National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W82-06797

ELECTROPLATING AND CYANIDE WASTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06798

STEEL INDUSTRY WASTES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5D.
W82-06799

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W82-06800

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06801

COAL AND COAL MINE DRAINAGE,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5B.
W82-06802

EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Research Lab. Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-06804

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5D.
W82-06805

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W82-06806

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
For primary bibliographic entry see Field 5C.
W82-06808

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5C.
W82-06809

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, NV.
For primary bibliographic entry see Field 5A.
W82-06810

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5C.
W82-06811

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W82-06812

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Calocerinos and Spina Co., Liverpool, NY.
For primary bibliographic entry see Field 5D.
W82-06914

LAND APPLICATION OF WASTEWATER,
Montgomery (James M.), Salt Lake City, UT.
For primary bibliographic entry see Field 5E.
W82-06915

TEXTILE WASTES,
Krebs (Paul B.) and Associates, Inc., Birmingham, AL.
For primary bibliographic entry see Field 5D.
W82-06916

FERMENTATION INDUSTRY,
Notre Dame Univ., IN., DepT. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06917

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-06919

RADIOACTIVE WASTES,
Oak Ridge National Lab., TN., Environmental Sciences Div.
For primary bibliographic entry see Field 5E.
W82-06920

DAIRY WASTES,
Kraft, Inc., Glenview, IL.
For primary bibliographic entry see Field 5D.
W82-06921

ORGANICS,
Washington Univ., Seattle. School of Public Health and Community Medicine, Department of Environmental Health.
For primary bibliographic entry see Field 5A.
W82-06922

ANAEROBIC PROCESSES,
Institute of Gas Technology, Chicago, IL.
For primary bibliographic entry see Field 5D.
W82-06923

MICROBIOLOGY: WATER,
Environmental Protection Agency, Cincinnati, OH., Drinking Water Research Division.
For primary bibliographic entry see Field 5B.
W82-06924

SUBSTRATE-ASSOCIATED MICROFAUNA,
Environmental Protection Agency Region VI, Dallas, TX.
For primary bibliographic entry see Field 5C.
W82-06925

MICROBIOLOGY: WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA., Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W82-06926

MICROBIOLOGY: DETECTION, OCCURRENCE AND REMOVAL OF VIRUSES,
Louisiana State Univ., Baton Rouge, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-06927

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W82-06928

SOLID WASTES AND WATER QUALITY,
Envirodyne Engineers, Knoxville, TN.
For primary bibliographic entry see Field 5B.
W82-06929

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5G.
W82-06997

ECONOMICS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5G.
W82-06998

INORGANICS,
Pope Scientific Inc., Menomonee Falls, WI.
For primary bibliographic entry see Field 5A.
W82-06999

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,
Battelle Columbus Lab., OH.
For primary bibliographic entry see Field 5D.
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